New Product

VDT-I-227/9 En
2.1983

ELECTRONIC IGNITION (EZ)

Digital-type ignition advance unit 0 227 921 001

1. General

The electronic ignition (semiconductor ignition) is s system in which the engine-speed-dependent ignition-timing adjustment is carried out by means of an electronic ignition-advance unit connected between the Hall generator and the ignition-system trigger box (Figs. 3 and 4).
The electronic ignition operates with extremely high accuracy, and is wear-free and maintenance-free during the complete lifetime of the engine. Further advantages are offered by the increase in MPG figures and improved driveability.

The ignition system is comprised of the following components:

Ignition distributor without mechanical centrifugal advance, but with vacuum advance unit and fitted Hall generator. The ignition distributor is of conventional construction.

Ignition coil with closure plug and TI-i trigger box using hybrid technology are of conventional design and have already been described in VDT-I-227/3.

Ignition advance unit for electronic adjustment of the ignition point depending upon engine speed (Figs. 1 and 2).

As from February 1983, Alfa Romeo have been equipping their GTV 6-2.5 USA model with an electronic ignition. A number of other vehicle manufacturers will fit this ignition system to their vehicles in the near future.

BOSCH
Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.

Components of the semiconductor ignition

Fig. 1

1 = Ignition distributor
    with Hall generator

2 = TI-i trigger box

3 = Ignition coil

4 = Ignition advance unit

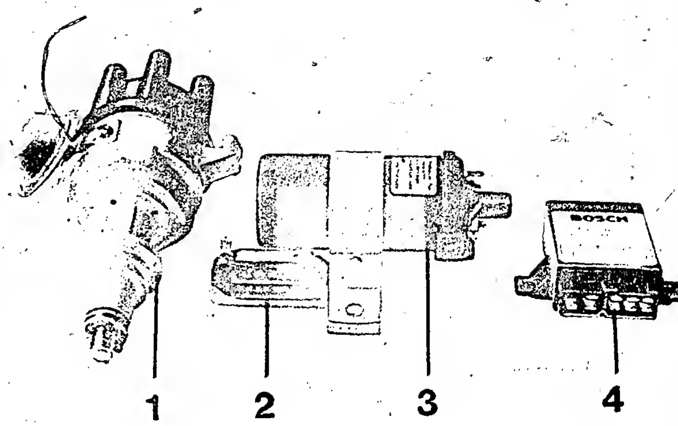


Fig. 2

4 = Ignition advance unit

5 = Microcomputer

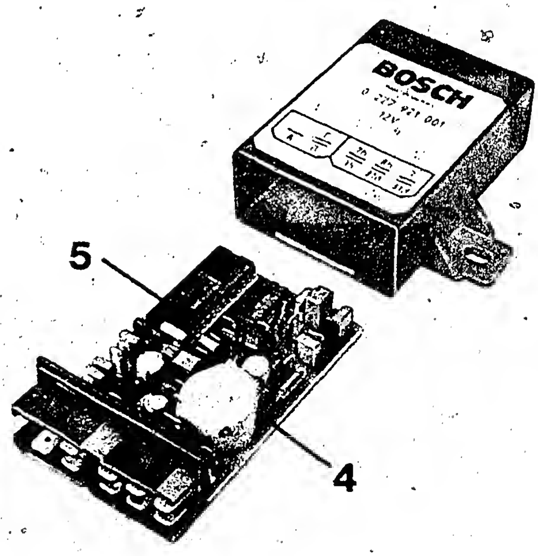
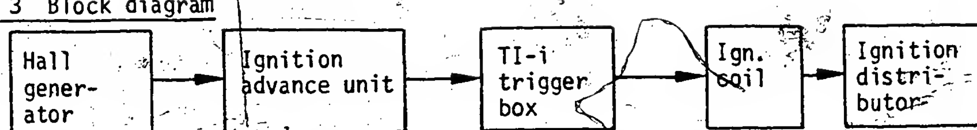
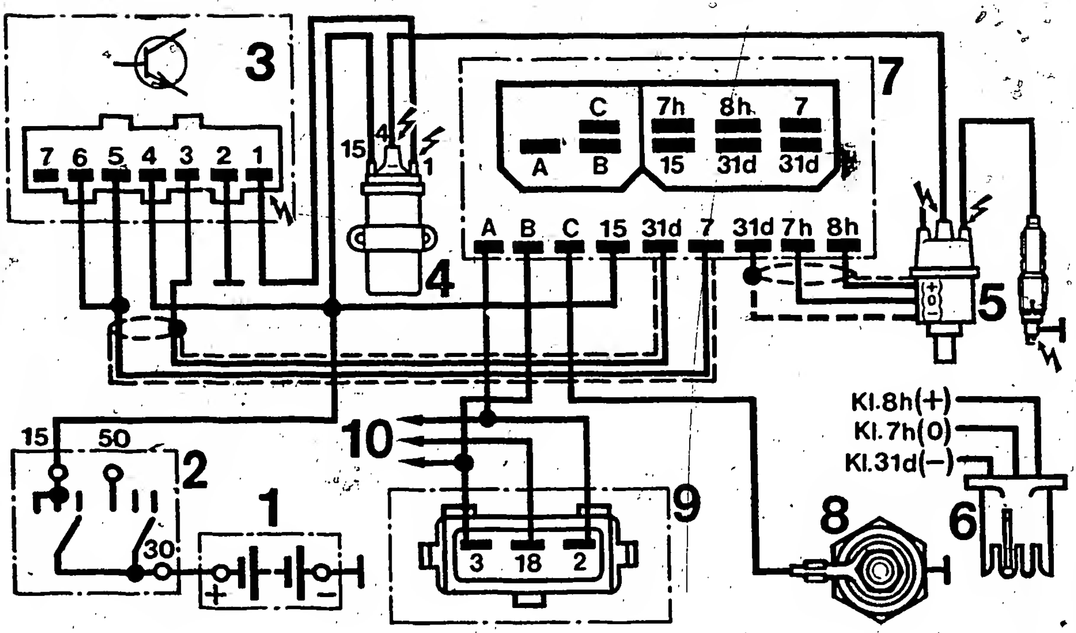


Fig. 3 Block diagram





Kl. = Term.

Fig. 4

Terminal diagram of the semiconductor ignition

1 = Battery
2 = Ignition/start switch
3 = Trigger box
4 = Ignition coil
5 = Ignition distributor

6 = Ignition-distributor plug
7 = Ignition advance unit
8 = Temperature switch
9 = Throttle valve switch
10 = to the L-Jetronic

ϟ = Dangerous voltages (400 - 25 kV)

2. Ignition advance unit, function

2.1 Engine-speed registration

With this ignition system, the engine speed is registered by the microcomputer which measures the period of the signal from the Hall generator (Fig. 5, Item 1). Using the engine speed, the microcomputer then computes the appropriate ignition angle and dwell angle taking into account the load and the temperature.

2.2 Start mode

The program stored in the microcomputer covers two specific modes: the "start" mode and the actual "operating" mode. The start mode is recognized by the computer by means of the engine speed, in other words using the period of the Hall-generator signal. The ignition point is triggered by the positive flank of the Hall generator signal (Fig. 5, Item 2).
The ignition system switches from the "start" mode to the "operating" mode when a given engine-speed threshold is exceeded. If, later on, the engine speed drops again below a given threshold, the system switches from "operating" mode to "start" mode.

2.3 Operating mode

Five independent characteristic curves are stored in the electronic ignition advance unit. These can be addressed depending upon such switching functions as temperature and throttle-valve switch position etc. Each switching function corresponds to one of the characteristic curves. The ignition point is adjusted by delaying the negative Hall-generator signal by the length of time calculated for the engine speed at that particular moment (T_V) (Fig. 5, Item 4). The delay time calculated in the ignition advance unit corresponds to the required ignition adjustment. The earliest (max. advance) ignition point is therefore determined by the negative flank of the Hall-generator signal (Fig. 5, Item 3). Additional mechanical adjustment of the ignition is realised by a vacuum advance unit fitted to the ignition distributor.

2.4 Electronic engine-speed limitation

The microcomputer has been programmed with the maximum engine speed of 6606 min^{-1}. Above this speed, an electronic spark cut-off comes into effect to cause engine-speed limitation. The principle of the electronic speed limitation lies in the fact that the final stage is blocked within a given engine-speed range. The result is that primary current ceases to flow and a spark cannot be generated.

2.5 Peak-coil-current cut-off

In those cases where peak coil current flows when the engine is stopped but the ignition is switched on, a peak-coil-current switch-off circuit in the ignition advance unit comes into effect.

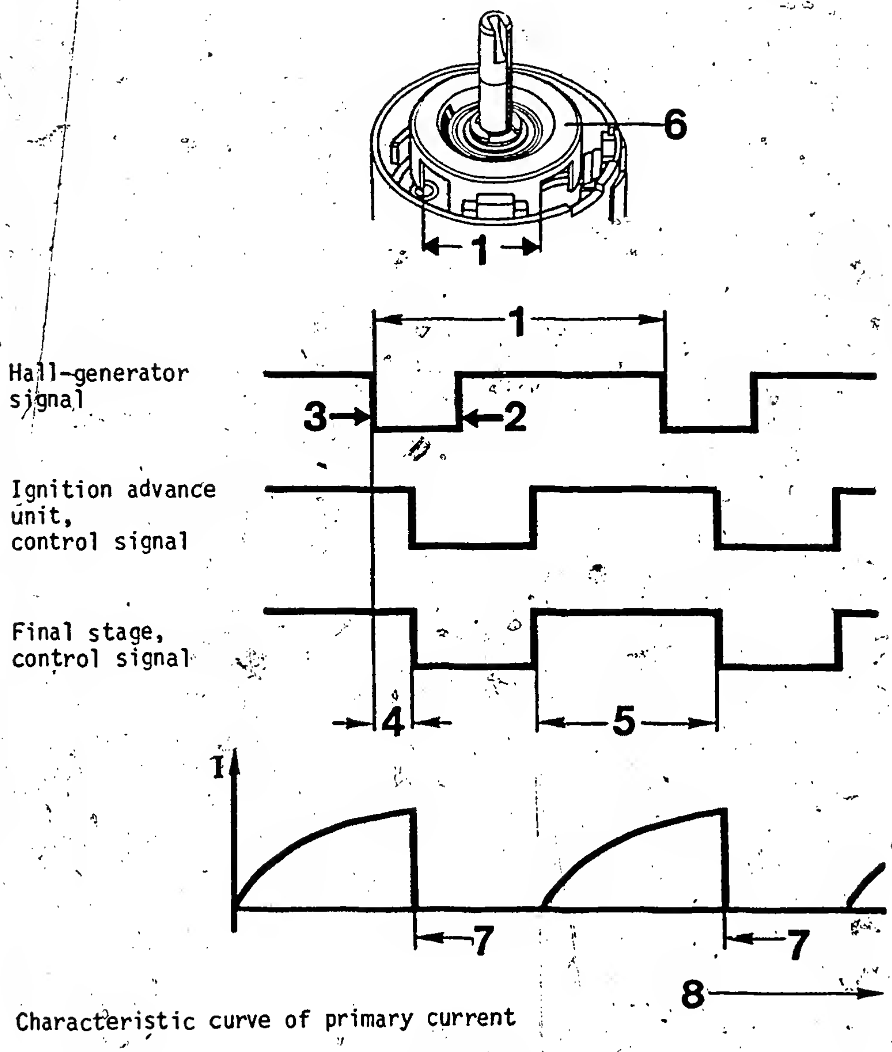


Fig. 5 Allocation of signals

1 = Period
2 = Start angle (positive flank)
3 = Most advanced ignition point (negative flank)
4 = Delay time (T_V) (= the ignition shift calculated by the microcomputer)
5 = Dwell period calculate by the microcomputer
6 = Trigger wheel
7 = Ignition point
8 = Time

Seite 6

3. TI-i trigger box, function

The ignition advance unit controls the TI-i trigger box in such a manner that the dwell-angle closed-loop control facility is put out of action. Generation of the dwell angle is taken over by the ignition advance unit in the form of a dwell-angle open-loop control (refer to Section 2.1). The TI-i trigger box then has only the function of limiting the primary current or of switching it on and off.

4. Workshop instructions

After the ignition distributor has been replaced, or rotated, it is necessary to carry out a basic timing adjustment.

Procedure: Pull the 4-pole plug from the ignition advance unit. Pull off the vacuum hose from the vacuum advance unit (ignition distributor). Close-off the vacuum hose. Run the engine at idle (800 - 900 min^{-1}). Turn the ignition distributor until 6° BTDC are reached. Replace the 4-pole plug on the ignition advance unit and refit the vacuum hose.

New Product

ELECTRONIC IGNITION (EZ)

13...39
I-227/11 En
1.1985

Control unit 0 227 400 508
Plastic-encapsulated ignition coil 0 221 501 007

1. General

A novel feature of this electronic ignition system is the EZ control unit (Fig. 2) designed using hybrid techniques, and the plastic-encapsulated ignition coil with pre-magnetization (Fig. 1).
In contrast to the EZ ignition systems already introduced, the triggering of the ignition point in this system takes place by means of an inductive segment system, whereby the pulse generator scans the segments on the flywheel ring gear (in the case of the Motronic, the pulse generator scans teeth).
As from 9.84, this ignition system is being fitted by the Daimler-Benz Co. to all its 190 E 2.3 - 16 passenger-car models.

2. Design

2.1 Ignition coil

The magnetic circuit of the ignition coil comprises an E-core and an I-core with a permanent magnet in the air gap for the purpose of pre-magnetization. Notwithstanding its small size (low weight), due to the pre-magnetization the ignition coil delivers a very high level of ignition energy.

The primary and the secondary windings are wound on plastic-material bobbins. The secondary winding is designed as a chamber-type winding. Both windings are encapsulated with synthetic resin in a common case. The encapsulated windings, the permanent magnet, and the iron core are glued together. The ignition coil is fastened to the bodywork by means of a bracket and frame (Fig. 1).

Workshop note: If the ignition coil is connected with wrong polarity (terminals 1 and 15), high ignition-energy losses will result which lead to ignition misses. In addition, the TI trigger box will also be overloaded. The connection pins have been provided with different diameters (M5 and M6) in order to prevent false connection.

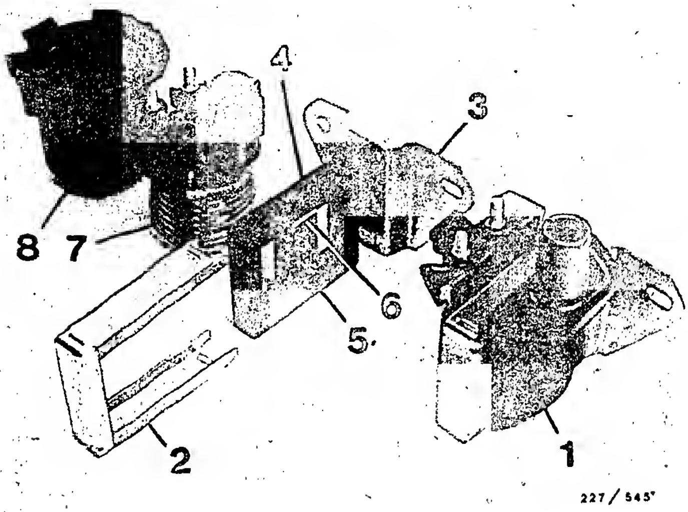


Fig. 1

1 = Plastic-encapsulated ignition coil, complete
2 = Frame
3 = Bracket
4 = I-core
5 = E-core
6 = Permanent magnet
7 = Plastic winding bobbin with primary and secondary windings
8 = Case

2.2 Control unit

The control unit incorporates electronic circuitry using the familiar hybrid techniques (similar to the TI trigger box). Contained in the control unit are the microcomputer, the signal processing, the pressure sensor, and the power output stage. Two 4-pole and a 1-pole plug connection are provided on the outside of the case, as well as a fitting for pressure detection. Refer to Fig. 2.
Due to the design of the control unit and the selection of appropriate components, the control unit is suitable for installation in the vehicle engine compartment.

Workshop note:

The baseplate of the control unit must be coated with heat-conductive paste for the purposes of heat dissipation (as with the TI trigger box).

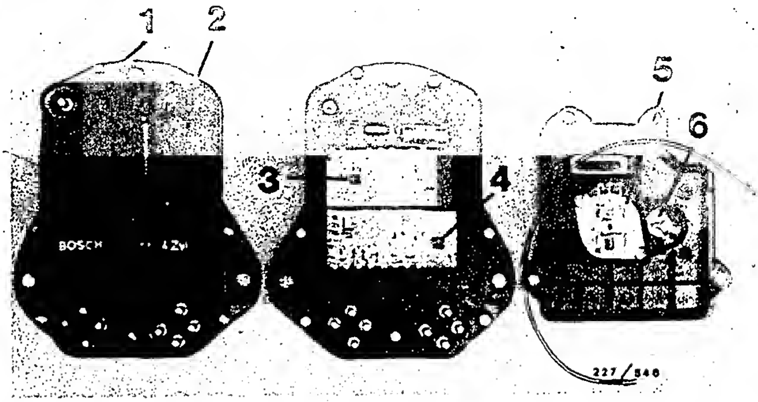
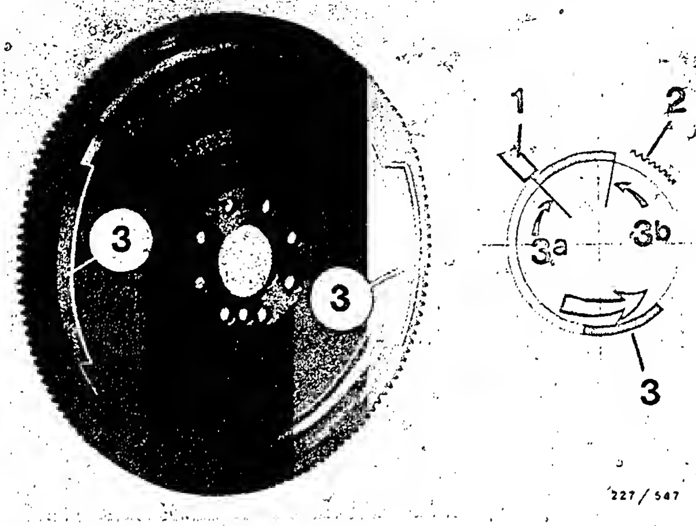


Fig. 2

1 = EZ control unit
2 = Pressure-sensor connection
3 = Microcomputer
4 = Power output stage
5 = Pressure sensor with processing circuitry
6 = Pressure compensation



1	=	Pulse generator	3a	=	Leading edge of segment (= 55° BTDC)
2	=	Flywheel ring gear			
3	=	Segments	3b	=	Trailing edge of segment (= TDC)

3. Control unit function

3.1 Engine-speed detection

The inductive pulse generator in the crankcase scans both segments on the flywheel ring gear. The leading edge of the segment generates a negative pulse and the trailing edge a positive pulse. These segment edges represent reference marks which are allocated to a particular angle of rotation of the crankshaft.
The microcomputer determines the engine speed by measuring the period of the pulse-generator signal (Fig. 3, Item 5) and, while taking load and temperature into account, calculates the appropriate ignition and dwell angle.

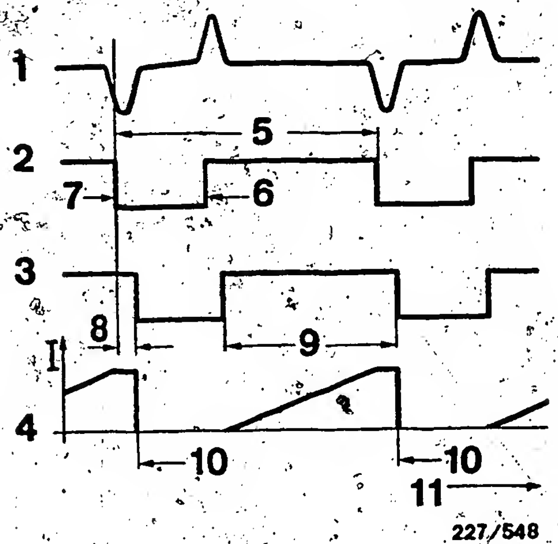


Fig. 3 Signal identification

1 = Pulse-generator output signal
2 = Processed pulse-generator signal
3 = Trigger-signal, output stage
4 = Primary-current characteristic
5 = Period
6 = Starting angle (positive flank)
7 = Most-advanced ignition point (negative flank)
8 = Delay (tv), ignition advance calculated by the microcomputer
9 = Dwell period, calculated by the microcomputer
10 = Ignition point
11 = Time

3.2 Start mode

The program stored in the microcomputer covers two different modes: the "start mode" and the "operate mode". The start mode is identified by the microcomputer from the engine speed, i.e. using the period of the pulse-generator signal. The ignition point is triggered by the positive flank of the pulse-generator signal (Fig. 3, Pos. 6).
The control unit switches from the "start mode" to the "operate mode" when the engine speed exceeds a given threshold. If the engine speed subsequently drops below a given threshold, the control unit switches from the "operate mode" to the "start mode".

3.3 Operate mode

An idle/overrun characteristic curve is stored in the EZ control unit, as well as an ignition map which is composed of 8 independent advance curves.
The optimum ignition angle is calculated for each engine mode, taking into aecount the load, temperature, idle switch and octane-rating adaptation.
The ignition point is shifted by delaying the negative pulse-generator flank for that period tv calculated by the microcomputer for the engine speed at the instant in question. See Fig. 3, Pos. 8. This delay period corresponds to the required ignition advance. The most-advanced ignition point is therefore determined by the negative flank of the pulse-generator signal (Fig. 3, Pos. 7).

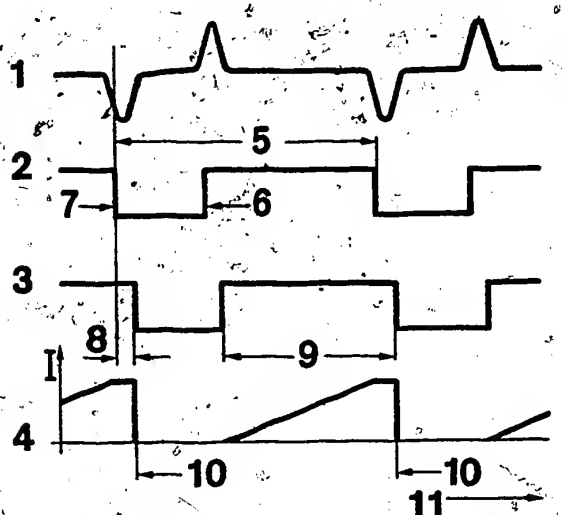


Fig. 3 Signal identification

1 = Pulse-generator output signal
2 = Processed pulse-generator signal
3 = Trigger-signal, output stage
4 = Primary-current characteristic
5 = Period
6 = Starting angle (positive flank)
7 = Most-advanced ignition point (negative flank)
8 = Delay ( ), ignition advance calculated by the microcomputer
9 = Dwell period, calculated by the loudspeaker
10 = Ignition point
11 = Time

3.4 Electronic engine-speed limiting

The microcomputer is programmed with the maximum engine speed of 7100 min^{-1}. Above this speed, an electronic spark switch-off becomes effective as speed limitation (the power output stage remains blocked).

3.5 Peak-coil-current cut-off

If, with the engine stationary and the ignition switched on, a quiescent current flows, this is switched off without sparks being generated.

3.6 Octane-rating adaptation

It can happen that when using premium-grade gasoline with low octane rating, the engine knocks (pings). In order to rule out the possibility of engine damage, the complete ignition map can be shifted max. 6 points in the "retard" direction using the coding plug. 6 points = 12° crankshaft (1 point = 2° crankshaft "retard").

3.7 Dwell-angle control

Excessive heating of the control unit is avoided by means of the dwell-angle individual-cylinder control system.

Workshops note: It is no longer necessary to test the dwell angle.

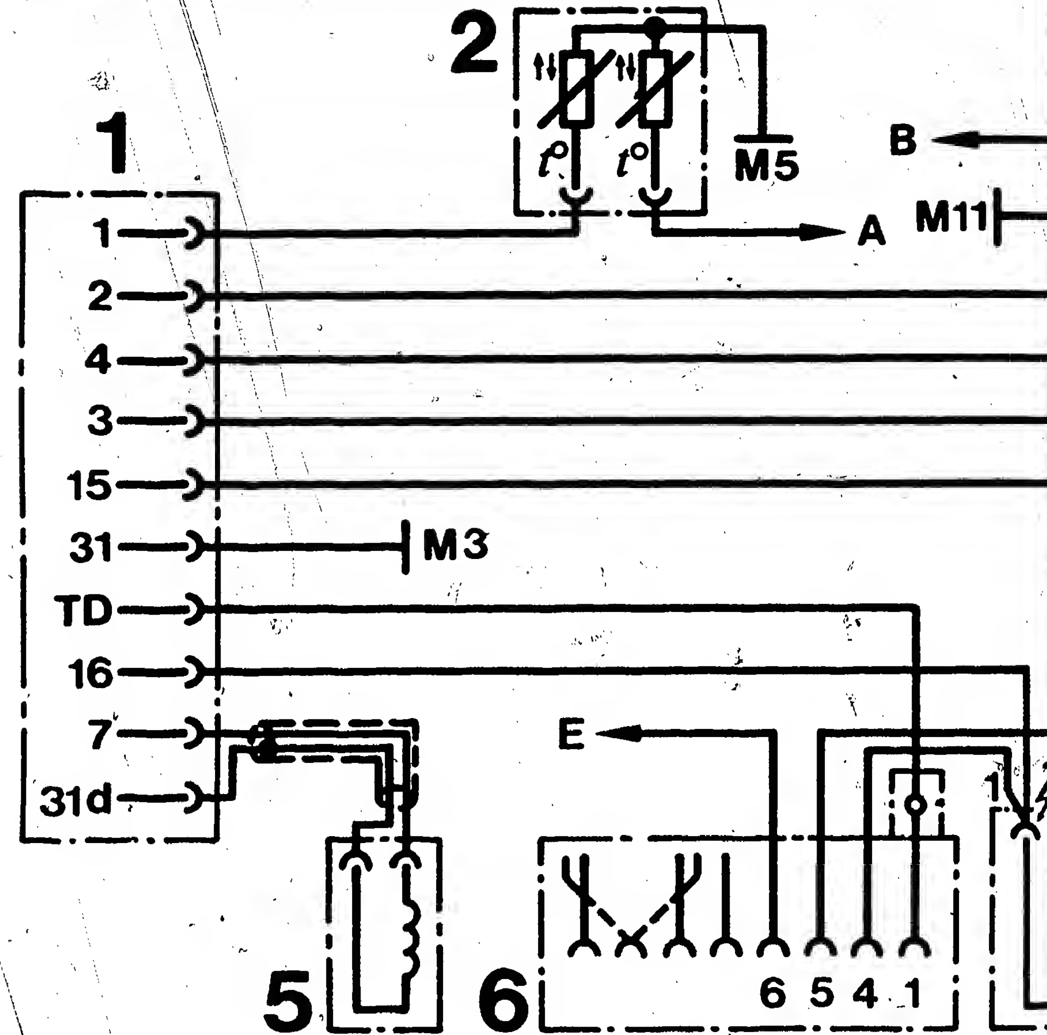
3.8 Safeguard provisions

If the vacuum sensor or the coolant temperature sensor should develop a fault, a "retarded" ignition point is selected from the ignition map in order to protect the engine.

Note:

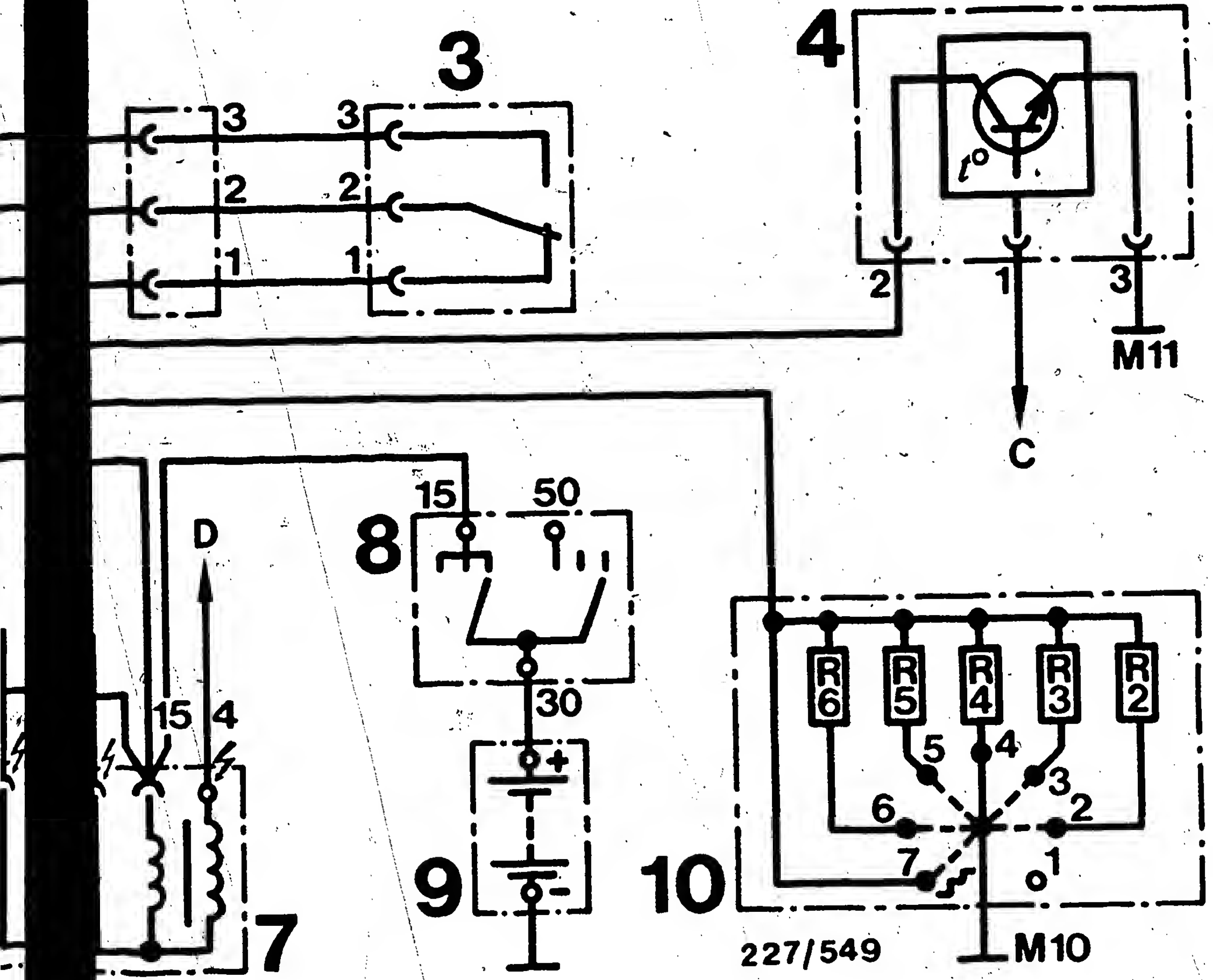
The electrical terminal diagram is printed on the following pages.

Please address comments and queries to our authorized representative in your country.



3. Electrical terminal diagram

1 = EZ control unit
2 = Coolant temperature sensor (double NTC)
3 = Throttle-valve switch
4 = Intake-air temperature sensor (with 25 °C switching electronics)
5 = Pulse generator
6 = Diagnostic socket
7 = Ignition coil (Caution! dangerous voltages 400 V - 25 kV)
8 = Ignition/start switch
9 = Battery
10 = Octane-rating adaptation (coding plug)



A = to control unit, KE-Jetronic
B = to control unit, KE-Jetronic
C = to electromagnetic coupling of engine fan
D = to high-voltage distributor
E = to the central electrics
Coupling: S No. 11 (Term. 30)

M3 = Ground, left wheel housing, ignition coil
M5 = Engine ground
M10 = Battery ground
M11 = Engine ground (vicinity of engine fan)

Electrical equipment

VDT-I-Allg. 068 En

9.1984

MODIFICATION OF THE ROTATIONAL SPEED LIMITING UNIT IN VEHICLES HAVING MOTRONIC OR ELECTRONIC IGNITION UNITS (EZ)

The rotational speed monitoring unit can be modified only by means of an intervention in the control unit, since for that purpose, a new ROM or programmable memory with other data contents would be necessary.

Bosch is unable to and not permitted to make that change, since the cutout speed is established by the car manufacturer and is part of the official homologation ("ABE").

Please direct any customers requesting such a change to the manufacturer of the vehicle concerned.

Please direct questions and comments on the contents to our authorized representative in your country.

Motor Vehicle Service Information

BOSCH

Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung.

New Product

VDT-I-227/6 En

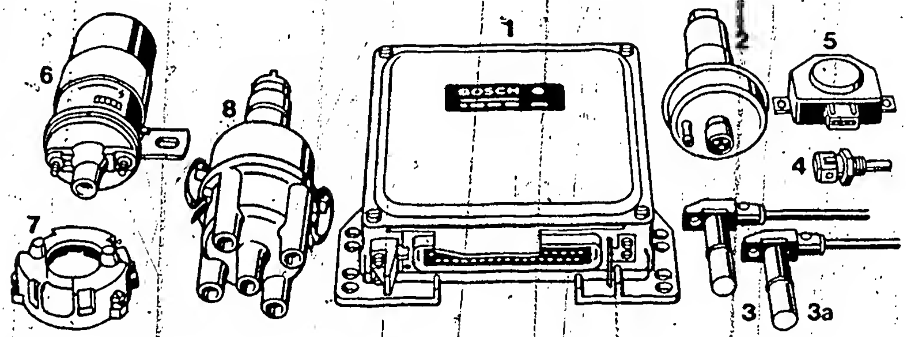
6.1981

ELECTRONIC IGNITION SYSTEM WITH SPARK-ADVANCE MAP (EZ-F)

Control unit 0 227 400 003 (with current limitation)

1. General

The electronic ignition system (EZ-F) is a microcomputer-controlled system for controlling the ignition angle. The control unit uses a programmed spark-advance map. It can thus generate the optimum ignition point for every operating condition. As from 6.1981, Alfa Romeo Co. have been equipping their Spider 2.0 model (USA-version) with this new ignition system.
Due to the fact that this electronic ignition system has only a minimum number of mechanical moving parts - vacuum and mechanical spark advance are no longer necessary - it can be regarded as being practically free from wear-and-tear. Apart from attention to the spark plugs, it is not necessary to service the system because the ignition point is programmed over the complete service life of the engine and the control unit, and cannot change of its own accord.



Components of the electronic ignition with spark-advance map

1 = Control unit
2 = Vacuum sensor
3 = Speed pickup
3a = Reference-mark pickup
4 = Temperature sensor
5 = Throttle-valve switch
6 = Ignition coil
7 = Protective cap for the ignition coil
8 = High-voltage distributor

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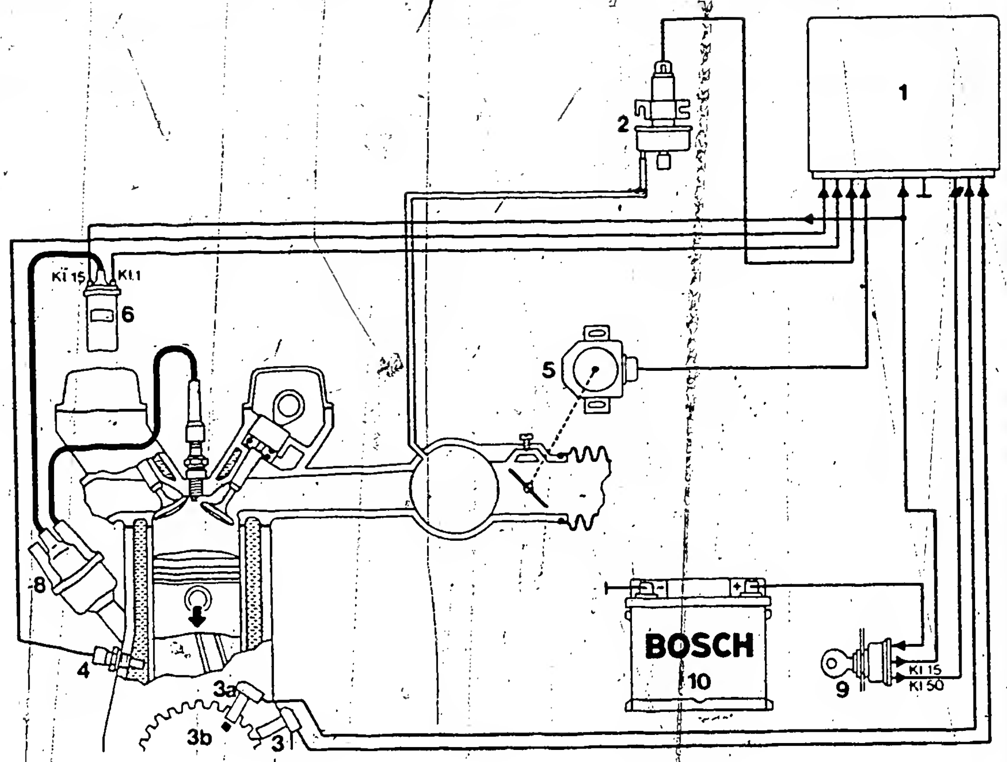
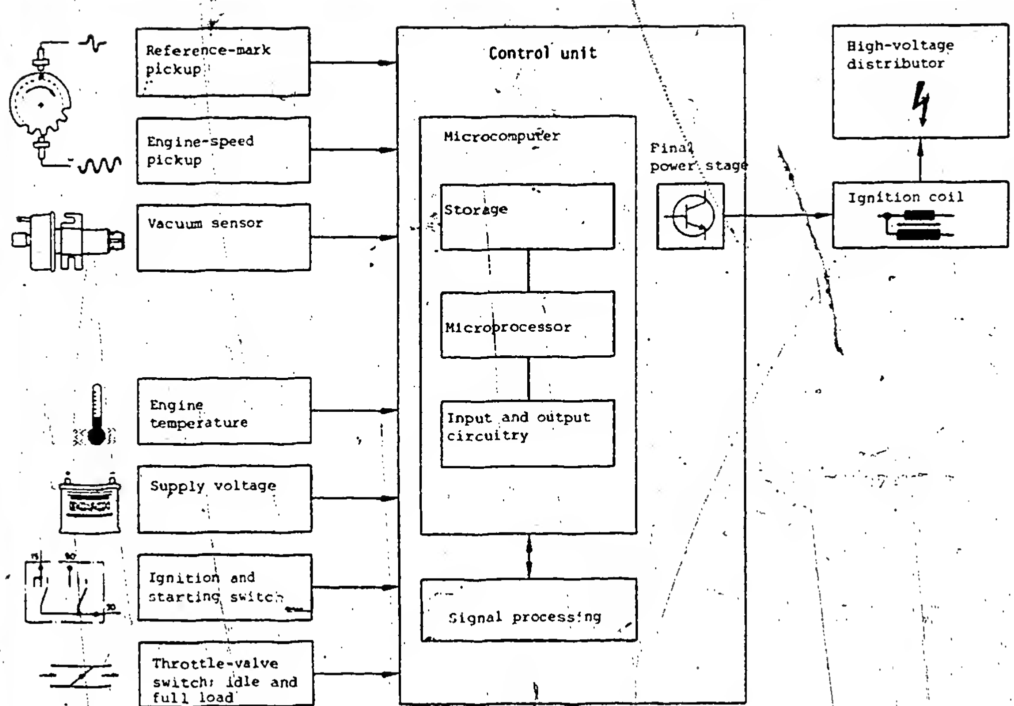


Electronic ignition with spark-advance map; system representation

1 = Control unit
2 = Vacuum sensor
3 = Speed pickup
3a = Reference-mark pickup
3b = Flywheel ring gear
4 = Engine temperature sensor
5 = Throttle valve switch
6 = Ignition coil
8 = High-voltage distributor
9 = Ignition and starting switch
10 = Battery

1-22716
Seite 3



Block diagram of the electronic ignition system with spark-advance map

Functional description

The system uses a digital control unit at the heart of which is a microcomputer. The microcomputer itself contains a microprocessor as its central component.

Sensors provide the control unit with a multitude of information regarding the engine operating conditions. The control unit continuously compares all this input data with the stored data and from the results calculates the optimum ignition point (ignition angle) and dwell period (dwell angle) for the operating conditions of the engine at that particular instant. Similarly, the computer calculates the most favorable charge for the ignition coil across the complete engine-speed range together with the relevant shortest-possible current-flow time.

The ignition and starting switch signals the control unit that cranking is taking place. As a result, the control unit outputs an ignition point which is independent of the spark-advance map.

Using a vacuum sensor, the load state in the intake manifold (intake-manifold pressure) is converted to an electrical value and also passed to the control unit.

In order to register the engine speed, an inductive pulse generator is used to count the number of teeth on the flywheel ring gear.
Information regarding the crankshaft position is provided by a further inductive pulse generator (reference-mark pickup, identical to the pulse generator used for registering the engine speed). The reference-mark pickup generates an impulse each time the reference mark on the flywheel ring gear passes by. Using the engine-speed signal and the reference-mark signal, the crankshaft position is calculated.

A dwell-period control which, dependent upon engine speed and supply voltage, determines the dwell period (dwell angle), ensures that the same primary current is always generated independent of the battery voltage and the engine speed with the result that energy is not wasted in the ignition coil. In addition, the final stage incorporates a current-limiting facility which means that the familiar ballast resistors are no longer required.

The computer program, of course, contains a peak-coil-current cutoff which prevents current from flowing through the ignition coil below a given engine speed. This measure prevents the battery from being discharged and the ignition coil from heating up when the ignition is switched on.

The power output stage in the control unit switches the primary current on and off in accordance with the timing calculated by the microcomputer.

The conventional ignition distributor was only able to provide two linear spark-advance curves. One of these was the centrifugal advance and the other the vacuum advance.

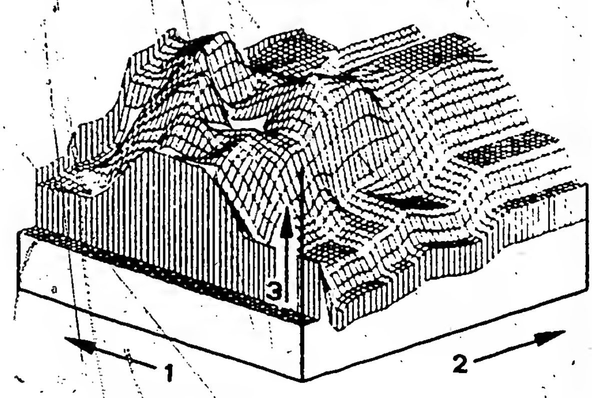
Instead of the mechanical centrifugal and vacuum advance mechanisms in the ignition distributor, this system uses the stored spark-advance map in the control unit which is vastly superior to the conventional spark-advance methods used up to now and which is matched to every conceivable operating condition of the engine.

Due to these new facts, the ignition distributor is now only required for high-voltage distribution.

The three-dimensional spark-advance map is plotted using the coordinates load and engine speed (see Fig. below).

Spark-advance map

1 = Load
2 = Engine speed
3 = Ignition angle



In accordance with the digital processing in the control unit, the spark-advance map is divided into small sections. Each crossing point (data point) of the resulting "mesh" occupies a memory location in the computer. This results in a large number of memory locations, in this case 256, each of which can be optimally defined. Using a special interpolation process, the computer calculates values which lie between the memory locations. With each engine revolution, the computer "inquires" about the operating condition or mode of the engine and, using the programmed data, calculates the ignition point again. This means rapid adaptation to changes in the operating conditions.

A special advantage of the EZ-F is the fact that during full-load operation the ignition point is always selected which results in maximum engine torque. This does not apply in ranges where the knock limit has to be taken into account. In this case, due to the long-term constancy of the system, the distance to the maximum ignition point (knock limit) can be reduced. This distance is now determined solely by the engine, the conditions surrounding it and its age, but not by the system.

In the part-load range, the ignition point is adjusted for minimum fuel consumption whilst still complying with emission standards.

New Product

VDT-I-227/8 En

11.1982

ELECTRONIC IGNITION WITH IGNITION-POINT MAP (EZ-F)

Trigger box 0 227 400 005

1. General

Since date of manufacture 10.82, Volkswagen AG have been fitting electronic ignition in their Polo Coupé GT. This electronic ignition system with ignition-point map (EZ-F) is a further-developed maintenance-free and wear-free system which makes it possible to electronically control the ignition angle for all operating conditions of a spark-ignition engine.

The principle component in this system is a microcomputer, in which the ignition angles which have been calculated during trials and testing, are stored in the form of an ignition-point map. Engine parameters such as speed, load (vacuum) and temperature are registered by means of sensors and fed to the trigger box in the form of electric signals. This system differs from the EZ-F described in VDT 227/6 En in the following points:

- Construction of the trigger box (see Fig. 1)
- Current-pulse controlled final output stage
- Electronic speed limitation
- Vacuum sensor in the trigger box
- Engine speed is registered by Hall generator (fitted in the ignition distributor)
- The crankshaft position is determined by the Hall generator (fitted in the ignition distributor).

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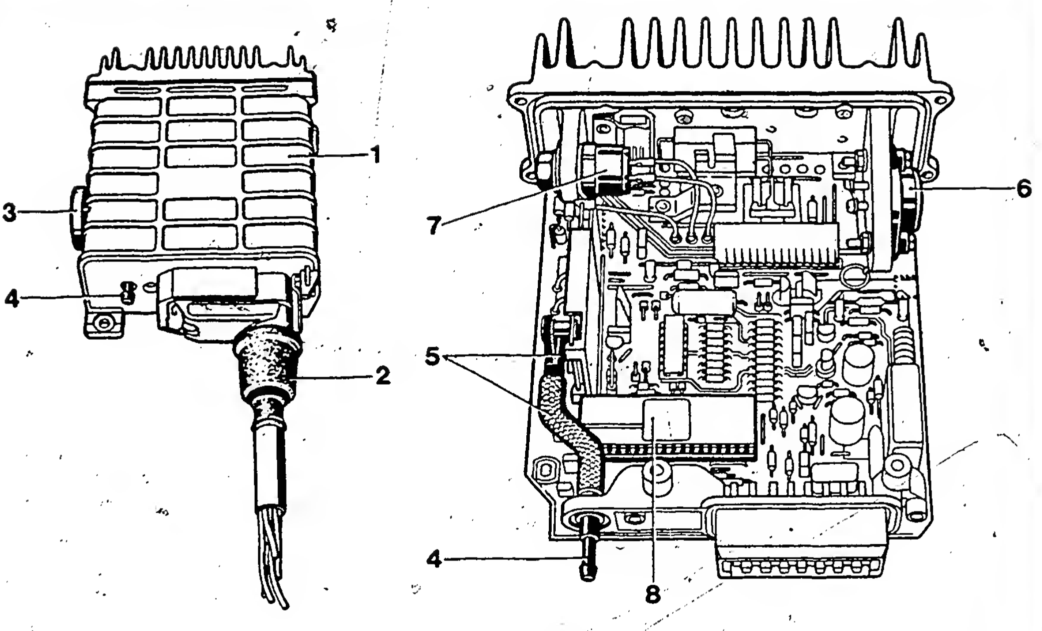


Fig. 1 Trigger box construction

1 = trigger box (viewed from outside)
2 = trigger-box plug
3 = pressure-compensating element
4 = vacumm connection
5 = pressure sensor with connection hose
6 = final output stage
7 = thyristor
8 = microcomputer

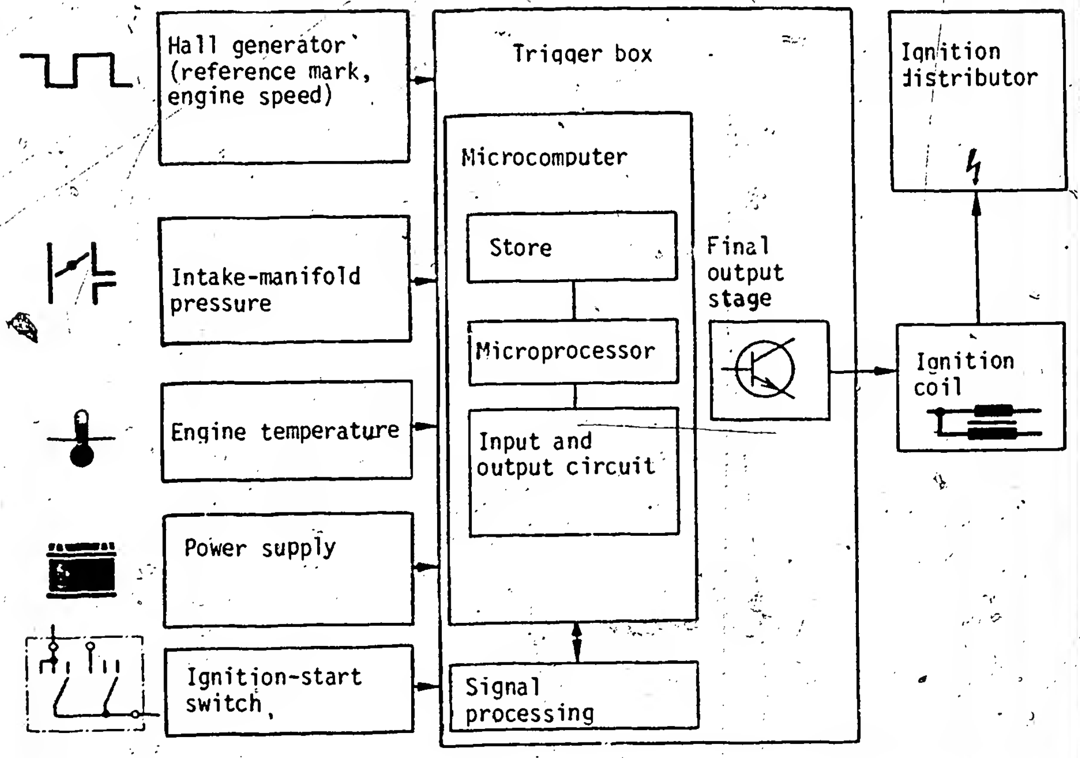


Fig. 2
Block diagram of electronic ignition with ignition-point map

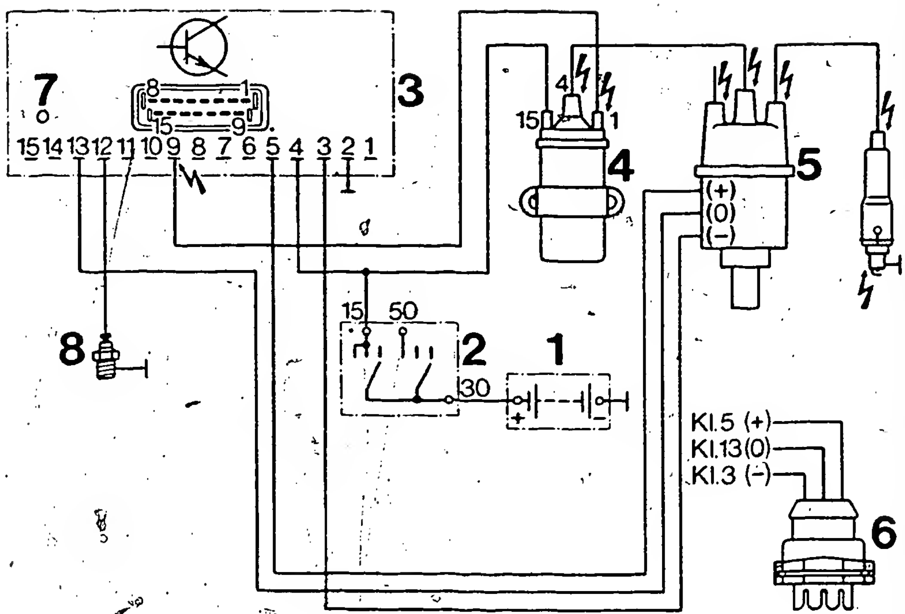


Fig. 3 Connections diagram

1 = battery
2 = ignition and starting switch
3 = trigger box
4 = ignition coil
5 = ignition distributor
6 = plug for ignition distributor
7 = vacuum connection
8 = temperature sensor

ϟ = dangerous voltages (400 V - 25 kV)

Kl. = terminal

2. Method of operation

2.1 Ascertaining the engine speed

In this ignition system the engine speed is registered by the microcomputer which measures the duration of the Hall generator signal (see Fig. 4, item 1), then the relevant ignition angle and dwell angle are calculated, taking into account load and temperature.

2.2 Starting condition

The program stored in the microcomputer covers two conditions: the "starting and the operating condition." The microcomputer receives information on the starting condition from the engine speed, i.e. from the duration of the Hall generator signal. The ignition point is triggered by the positive flank of the Hall generator signal (see Fig. 4, Item 2).
The ignition system switches from the "starting condition" to the "operating condition" when a given speed threshold is exceeded. If the speed then sinks below a certain threshold, then the ignition system is switched again from the "operating condition" to the "starting condition."

2.3 Operating condition

In the "operating condition" the ignition point is adjusted, taking into account speed, load (vacuum) and temperature, by delaying the negative Hall generator signal flank by the length of time calculated for the engine speed at that moment (Tv), see Fig. 4, Item 4.
The delay corresponds to the desired ignition adjustment.
The most advanced ignition point is therefore determined by the negative Hall generator signal flank.

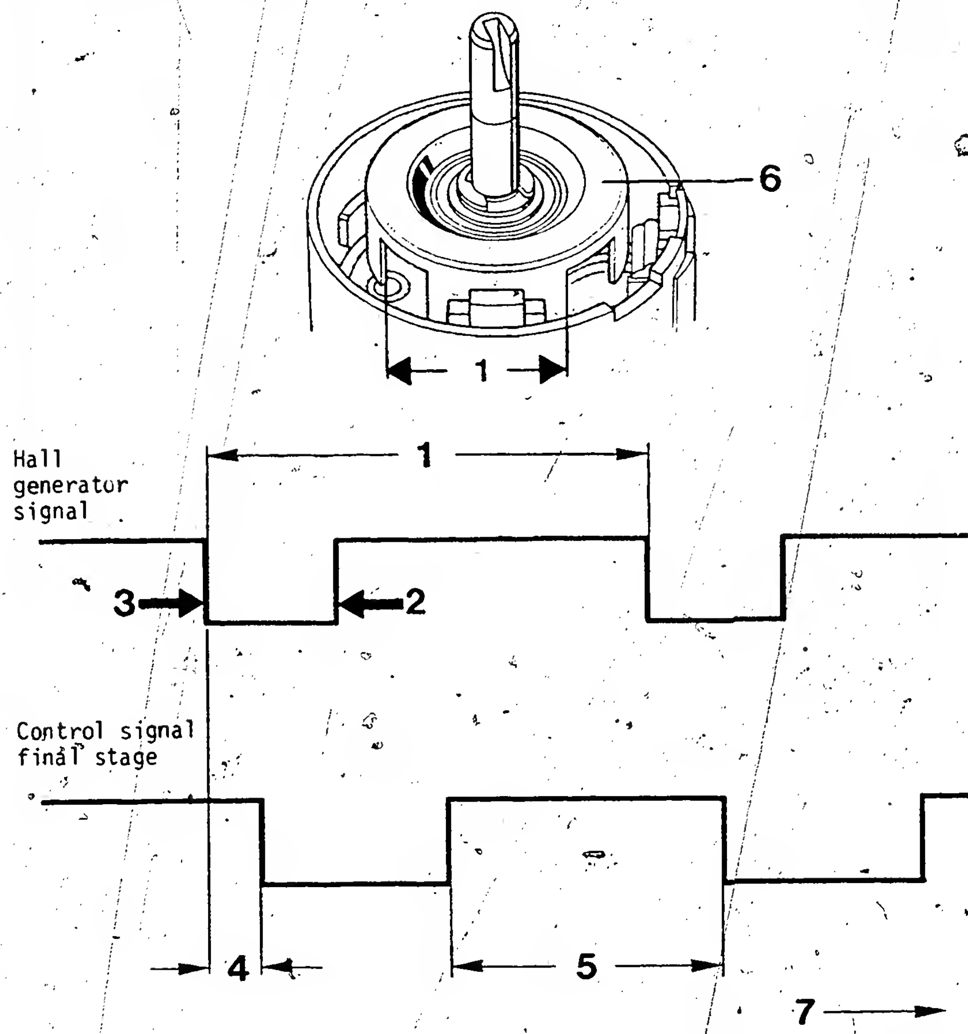
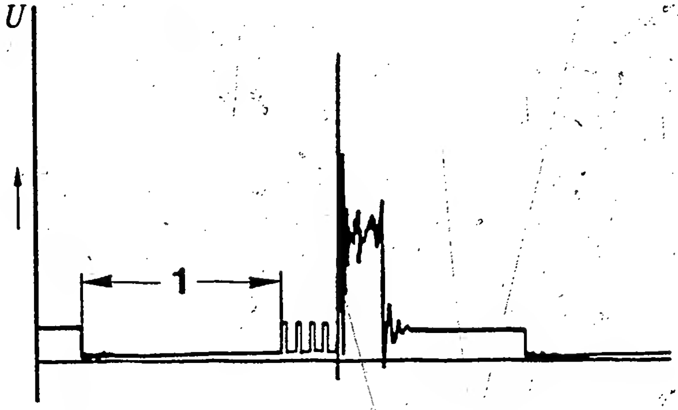


Fig. 4 Signal arrangement

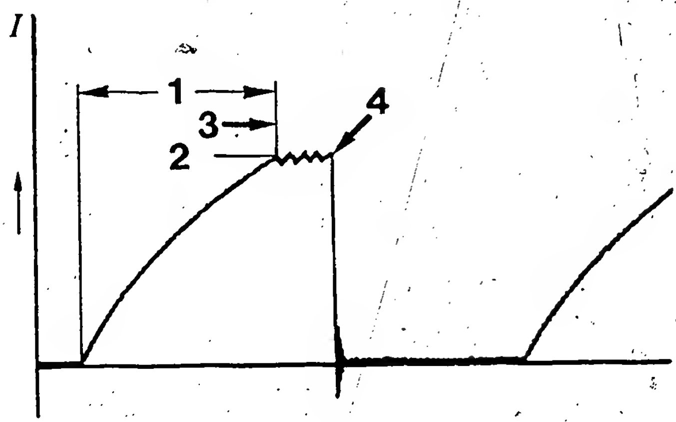
1 = duration of signal period
2 = starting angle (positive flank)
3 = most advanced timing point possible (negative flank)
4 = delay time (Tv)(ignition adjustment calculated by microcomputer)
5 = dwell period calculated by microcomputer
6 = trigger wheel
7 = time

2.4 Current pulse controlled final output stage

The advantage of such a pulse-controlled final stage is that it exhibits less power loss.



Primary voltage curve



Primary current curve

Fig. 5

1 = final stage conducting (primary current flows)
2 = primary-current nominal value
3 = start of current-pulse control (final output stage is then switched on and off for short periods)
4 = final stage and thyristor blocked (ignition point)

2.5 Electronic speed limitation

The electronic speed limitation is based on the fact that the final output stage remains blocked above a given engine speed.
In this way no primary current can flow; no ignition spark can form.

3. Workshop notes

After the ignition distributor has been removed (or rotated), with the Hall generator fitted, a basic ignition timing must be carried out.
Sequence: Pull the lead off of the temperature sensor
Caution: The lead must not touch vehicle ground or coolant hoses!
Run the engine at between 2000 and 3000 min^{-1}.
Turn the ignition distributor until 5° BTDC have been reached.
Plug in the temperature-sensor plug again.

Due to the fact that the final output stage is current-pulse controlled, the primary and secondary ignition patterns differ from the conventional ones. See below for examples.

Primary pattern

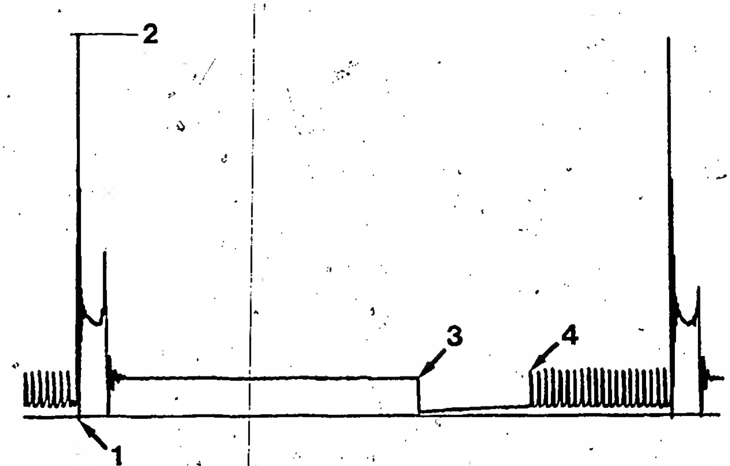
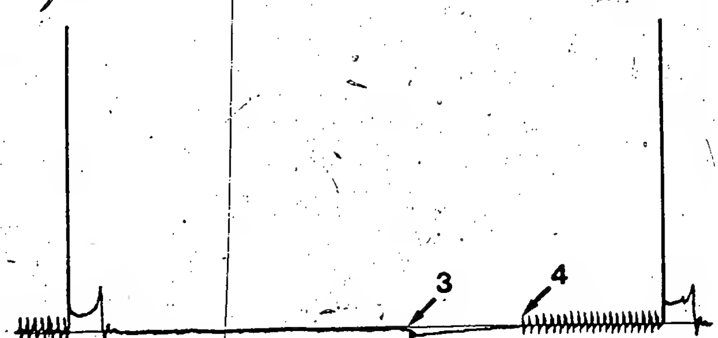


Fig. 6

1 = transistor and thyristor blocked (ignition point)
2 = max. primary current (Zener voltage)
3 = transistor conducts (primary current flows)
4 = Start of cureent-pulse control

Secondary pattern



New Product

SEMICONDUCTOR IGNITION WITH KNOCK CONTROL (EZ-K)

Ignition advance unit	0 227 921 002
Knock control unit	0 261 201 002
Knock sensor	0 261 231 001

1. General

The semiconductor ignition with knock control comprises the following components:

Ignition distributor without centrifugal advance, but with vacuum and pressure advance units and fitted Hall generator. The ignition distributor is of conventional construction.

Ignition coil with closure plug and TI-i trigger box using hybrid circuit technology (both already described in VDT-I-227/3).

Ignition advance unit for electronic adjustment of the ignition point dependent upon engine speed (Fig. 1).

Knock control unit with knock sensor for retarding the ignition dependent upon knock recognition (Figs. 2 and 3).

As from December 1982, Peugeot Co. have been equipping their 505 Turbo model with the semiconductor ignition system incorporating knock control.

1.1 Advantages of knock control:

- Adaptation to the various qualities of fuel
- The safety margin to the knock limit need no longer be maintained (the result is that increased compression can be used, while at the same time the fuel consumption can be reduced or the power increased).
- Compensation for fabrication spread (with the result that fuel consumption and power are improved)
- Automatic adaptation to changes in the knock limit (caused, for instance, by combustion-chamber deposits, pressure and/or temperature variations)
- Wear-free electronic change of the ignition point dependent upon the knock limit).

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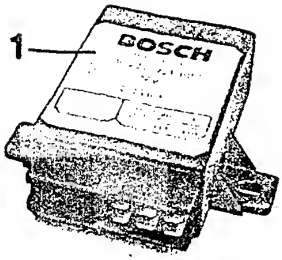
B4



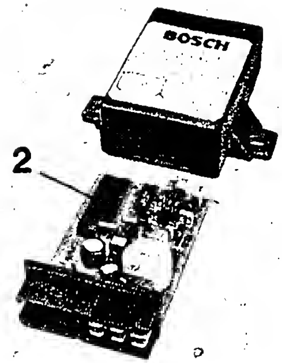
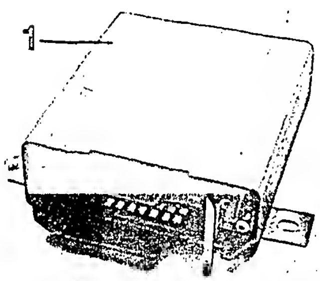


Fig. 1 1 = Ignition advance unit 2 = Microcomputer



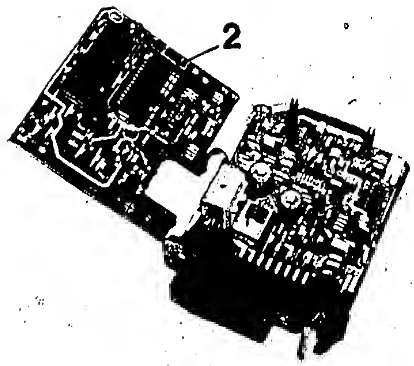
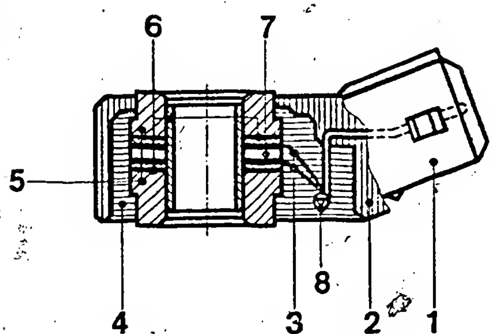


Fig. 2 1 = Knock control unit 2 = Microcomputer



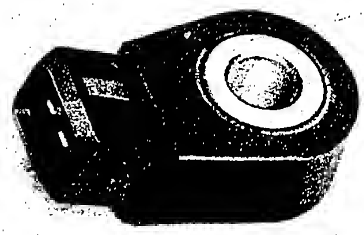


Fig. 3 Knock sensor

1 = Connection plug
2 = Sensor casing
3 = Contact discs
4 = Sealing compound
5 = Seismic elements
6 = Insulation
7 = Piezo ceramic
8 = Protective resistor

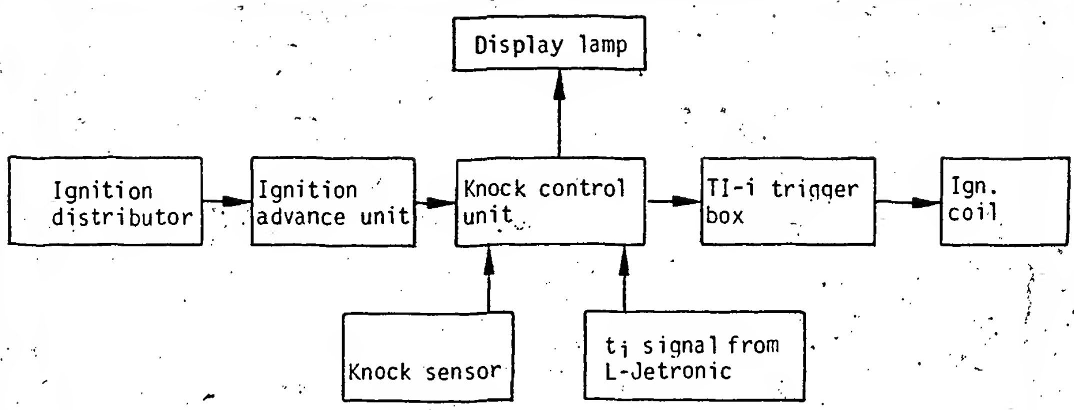


Fig. 4 Block diagram of semiconductor ignition with knock-control facility

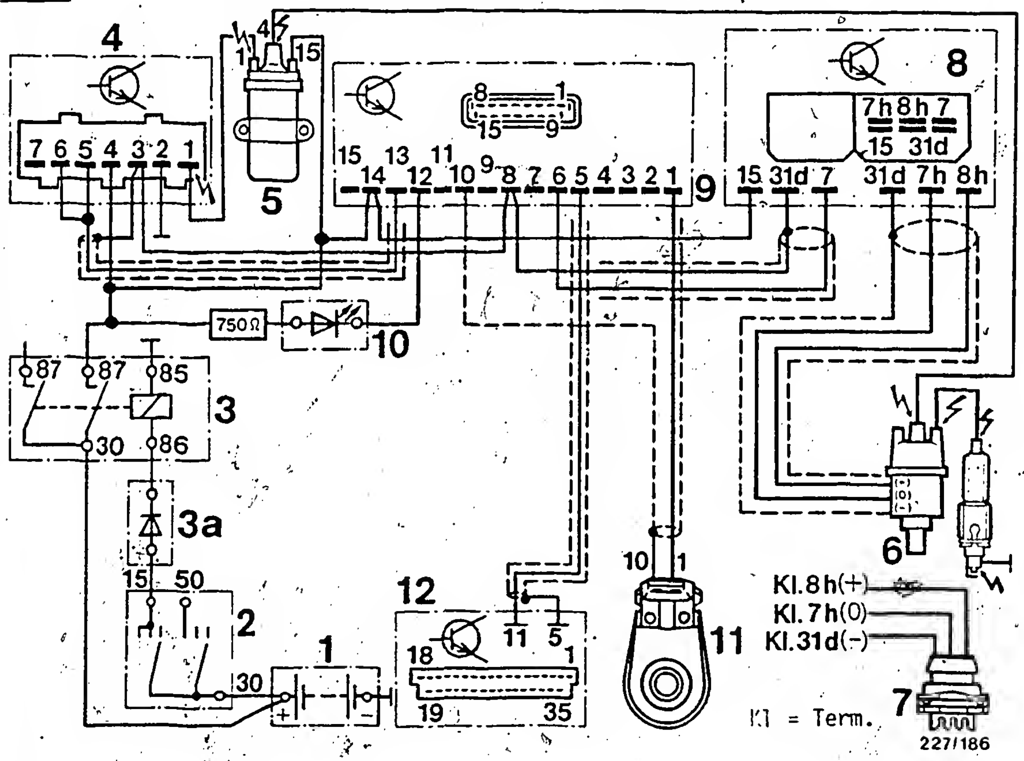


Fig. 5 Terminal diagram of the semiconductor ignition with knock-control facility

1 = Battery
2 = Ignition/start switch
3 = Supply relay
4 = Trigger box
5 = Ignition coil
6 = Ignition distributor
7 = Ignition-distributor plug
8 = Ignition advance unit

9 = Knock control unit
10 = Display lamp
11 = Knock sensor
12 = L-Jetronic

ϟ = Dangerous voltages (400V - 25 kV)

2. Ignition advance unit, function

2.1 Engine-speed registration

In this ignition system, the engine speed is registered by the computer measuring the period of the Hall generator signal (Fig. 6, Item 1). The appropriate ignition and dwell angles are then computed from the signal.

2.1 Start mode

The program stored in the microcomputer covers two specific modes: the "Start" mode and the actual "operating" mode. The start mode is recognized by the microcomputer by means of the engine speed, in other words through the period of the Hall-generator signal. The ignition point is triggered by the positive flank of the Hall-generator signal (Fig. 6, Item 2).
The ignition system switches from the "start" mode to the "operating" mode when a given engine-speed threshold is exceeded. If, later on, the engine speed drops again below a given threshold, the system switches from "operating" mode to "start" mode.

2.3 Operating mode

In the "operating" mode, the adjustment of the ignition point - taking into account the engine speed - is carried out by delaying the negative Hall-generator flank by the length of time calculated for the engine speed at that particular moment (T_V)(Fig. 6, Item 4). The delay time calculated in the ignition advance unit corresponds to the required ignition adjustment. The earliest (max. advance) ignition point is therefore determined by the negative Hall-generator flank (Fig. 6, Item 3).
An ignition-timing characteristic is programmed in the ignition advance unit (microcomputer). This characteristic can be shifted in the retard or advance direction by the ignition advance unit depending upon the knock tendency of the engine.
The load-dependent ignition adjustment of the system is mechanical by means of either a vacuum or a pressure unit on the ignition distributor.

2.4 Electronic engine-speed limitation

The microcomputer has been programmed with the maximum engine speed of 7,500 min^{-1}. Above this speed, an electronic spark cut-off comes into effect to cause speed limitation. The principle of the electronic engine-speed limitation lies in the fact that the final stage is blocked within a given engine-speed range. The result is that primary current ceases to flow and a spark cannot be generated.

2.5 Peak-coil-current cut-off

In those cases where peak coil current flows when the engine is stopped but the ignition switched on, a peak-coil-current switch-off circuit in the ignition advance unit comes into effect.

3. Function, TI-i trigger box

The ignition advance unit controls the TI-i trigger box in such a manner that the closed-loop dwell-angle control becomes ineffective. The ignition advance unit now takes over the dwell-angle generation by applying an open-loop dwell-angle control (Section 2.1). The TI-i trigger box now only has the task of limiting the primary current or switching it on and off. All other functions are taken over by the ignition advance unit and knock control unit.

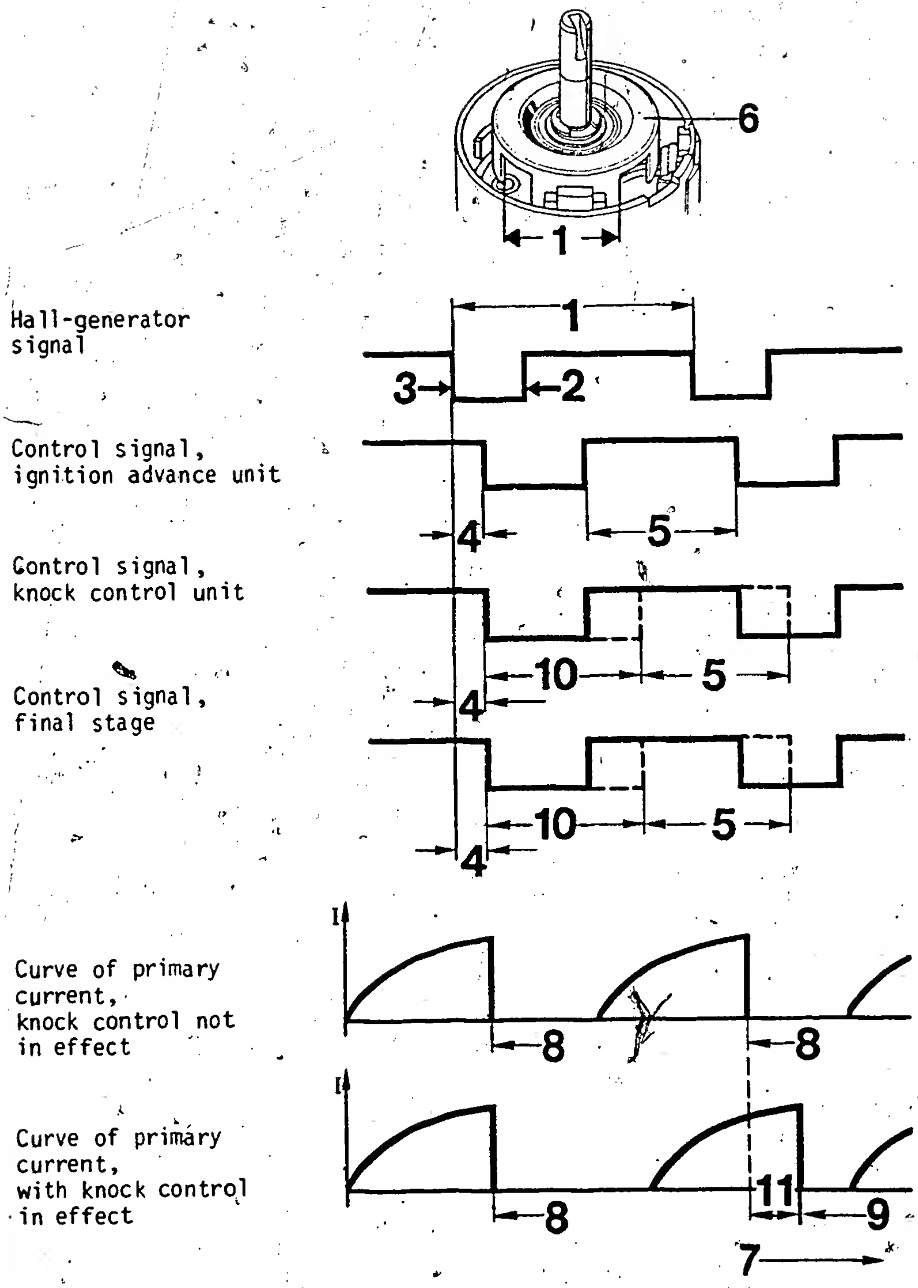


Fig. 6 Allocation of signals

1 = Period
2 = Start angle (positive flank)
3 = Most advanced ignition point
4 = Delay time (T_V) (= the ignition shift calculated by the microcomputer)
5 = Dwell period calculated by the microcomputer
6 = Trigger wheel
7 = Time
8 = Ignition point, knock control not in effect
9 = Ignition point, knock control in effect
10 = With the knock control in effect, the "open" time changes but the dwell period remains constant
11 = Shift to retard (knock control in effect)

4. Knock control function

4.1 Knock sensor

The knock sensor is fitted with a piezo-electric element. This converts the amplitude of the engine vibrations into an electrical signal (Fig. 9).

4.2 Knock recognition

The knock sensor is screwed onto the engine block at a selected point. It generates an electrical signal which takes into account not only "ignition knock", but also all the other noises from the engine such as the closing of the valves. Due to the fact that the knock signal usually contains frequencies from about 5 ... 15 kHz, the knock sensor must be designed to have a wide-band response. Filtration of these signals takes place in the knock control unit.

4.3 Ignition-point adjustment

The ignition advance unit provides a particular ignition point. Every time that ignition knock occurs, the knock control unit shifts this ignition in the retard direction by a given angular increment (Fig. 6 and Figs 7 and 8, Item 3). The shift is achieved by delaying the triggering signal for the ignition final stage (TI-i trigger box). The result of this shift is that the tendency for the engine to knock is reduced. After a given number of working cycles without ignition knock (Figs. 7 and 8, Item 5), the ignition point is again shifted back in the advance direction by a given angular increment (Figs. 7 and 8, Item 4). This process is repeated until the ignition angle specified by the ignition advance unit (microcomputer) is reached again (Figs. 7 and 8, Item 2). Knock recognition and ignition angle retard are carried out individually for each cylinder (a single cylinder is depicted in Figs. 7 and 8). The maximum shift in the retard direction is limited to 8° crankshaft.
The step-width (number of working cycles without ignition knock after a shift has been made in the advance direction) depends upon the engine speed (Figs. 7 and 8, Item 5).

The knock control is designed to function reliably beyond the engine limit speed.

4.4 Dependency of knock control on the load

As already discussed, the ignition angle is retarded when ignition knock occurs at full load or high partial load. In order to prevent this retard of the ignition angle from being transferred to the low load range and to idle (e.g. with rapid change from full load to idle), below a given load level the ignition-angle shift computed by the knock control unit is immediately changed to zero. The load is registered by evaluation of the t_i signals (duration of injection) from the L-Jetronic. A load characteristic curve as a function of engine speed is stored in the microcomputer of the knock control unit. Above this curve, all knock-control functions are fully effective. Below the curve, the ignition angle is completely unaffected by the knock control, and the ignition angle generated by the ignition advance unit is effective.

4.5 Safety functions

A monitoring program in the microcomputer ensures that in case of system defect, the engine cannot be damaged by ignition knock.

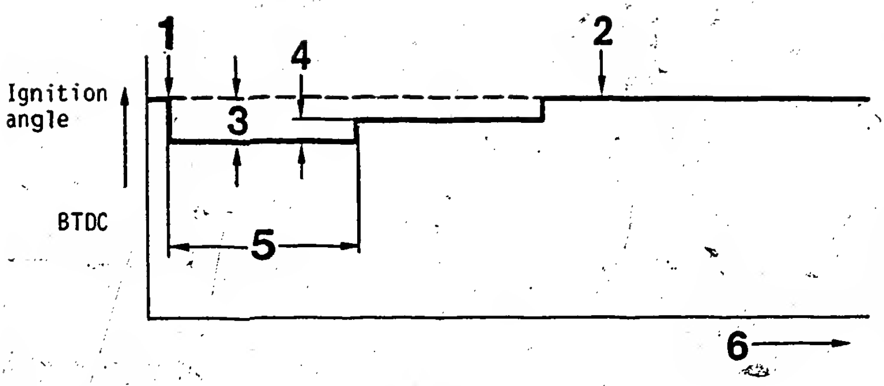


Fig. 7 Sequence of individual combustion knocks

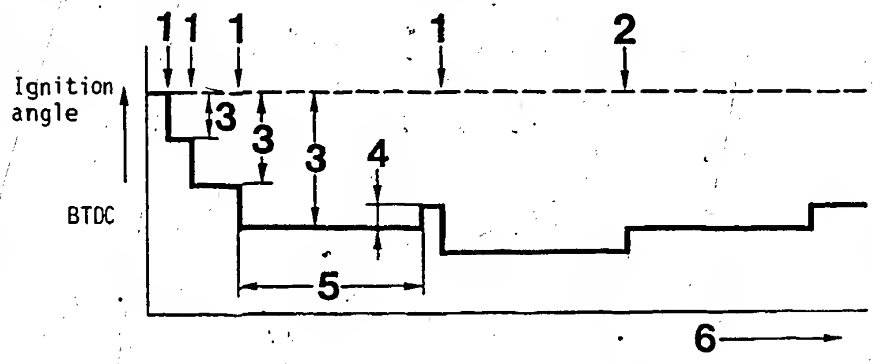


Fig. 8 Continued combustion knocks

1 = Knock occurs
2 = Set value presented by the ignition advance unit
3 = Ignition angle shift towards retard for each knock
4 = Ignition angle shift towards advance for each step
5 = Step width (number of working strokes after which a shift towards advance takes place)
6 = Working stroke

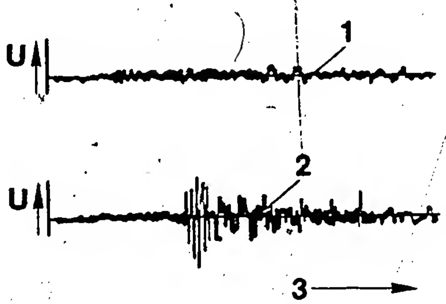


Fig. 9

1 = Oscilloscope display of a knock-sensor signal without knocking
2 = Oscilloscope display of a knock-sensor signal with knocking
3 = Time

The monitoring program is composed of the following sections:

4.5.1 Knock-sensor monitoring

Above an engine speed of 3,300 min^{-1} the knock sensor, knock-sensor connecting lines and knock-sensor mounting on the engine are continuously monitored. The structure-borne noise emanating from the engine is also monitored. A specified noise-level value is stored in the microcomputer, and if this level is not reached this fact is used to signal a defect. The knock-control unit then shifts the ignition-angle curve by a given amount in the retard direction above the precribed load line. The safety margin is maintained until the ignition is switched off, unless a defect is detected and stored in the micro-computer which then triggers appropriate safety measures above the load curve. After starting the engine again, knock-sensor monitoring is resumed.

4.5.2 Testing the knock-sensor evaluation-circuit

In the engine-speed range between 500 and 1600 min^{-1}, the microcomputer generates and transmits a test pulse which checks the functioning of the knock control unit from the knock-sensor connection and into the micro-computer itself. If the test pulse does not trigger the specified responses in the knock-control unit, it is assumed that a defect is present and this leads to the reactions as described in 4.5.1.

4.5.3 Supply-voltage monitoring

A supply voltage of $V_{Batt.}$ > 6V suffices for the ignition function of the knock-control unit. The evaluation circuit requires a supply voltage > 9V in order to operate correctly. In the speed range above 500 min^{-1}, a battery voltage of less than 9 V triggers the safety shift as described in 4.5.1. This safety measure though, is automatically revoked as soon as the battery voltage rises above 9V again.

4.5.4 Failure of the t_i signal

During the actual injection, the L-Jetronic t_i signal is < 2V, in other words if an open-circuit occurs in the connecting line or a ground short-circuit is present, this is reported as "full-load" and, as a result, the knock control comes into action over the complete engine speed/engine load range. This means that the protective measures as per 4.5.1, 4.5.2 and 4.5.3 are effective over the complete engine speed/engine load range.

Note: Connecting the t_i line to battery + puts the knock control out of action (non-monitored failure case!).

5. Notes for the workshop

The knock sensor is robust enough to withstand the vibrations from the engine. Heavy blows with a hammer, wrench or other tools could damage it though. If the knock sensor is removed, the specified tightening torque (11 ... 15 Nm) must be complied with when replacing. If the incorrect torque is used this can lead to incorrect functioning of the knock control and/or thread damage in the cylinder bock.

13...39

ELECTRONIC IGNITION
WITH KNOCK CONTROL (EZ-K)
After-sales service procedure

VDT-I-227/111 En
8.1984
supersedes Ed. 7.1983

Description of the system

The microcomputer of the ignition timing unit processes the engine-speed signal from the Hall pulse generator in the ignition distributor and switches the TI-I trigger box at the calculated instant of ignition. A knock-control unit which is connected in between delays the trigger pulse for the TI-I trigger box if there is knocking.

Users

Peugeot is the first vehicle manufacturer to equip its 505 Turbo-Injection as of 01.83 with electronic ignition with knock control (EZ-K).

Components

Ignition distributor	0 237 035 ..
Ignition timing unit	0 227 921 ..
Knock control unit	0 261 201 ..
TI-I trigger box	0 227 100 ..
Knock sensor	0 261 231 ..

The precise part numbers are listed on the respective vehicle equipment microfiche AA ....

Technical Bulletin

Service parts/exchange parts

The Hall pulse generator* in the ignition distributor and the knock sensor are service parts; ignition timing unit and knock control unit are available as exchange parts** after the expiration of the warranty period (1 year).

*   see microfiche EE 00
** see microfiche WB :.

Test concept

The system is tested in the vehicle using the motor-tester. Special tools are not required.

Technical documentation

Technical Bulletin "New product" VDT-I-227/10.
Trouble-shooting instructions and test specifications: SIS microfiche PEU 02/J2.

System training

Integrated in the ignition courses.

Retrofitting

This system is not intended for retrofitting.

Warranty procedure

Complaint components should be sent in during the warranty period for warranty assessment by the responsible representative in your country.

Published by:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)

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B15

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B17

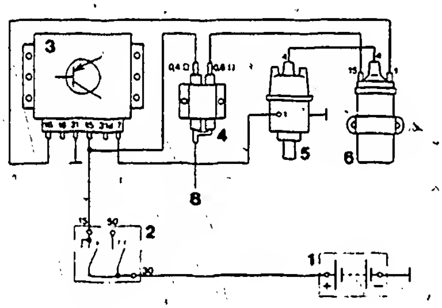
0 227 051 021 – TCI – Trigger Box
Emergency Measure in case of breakdown

VDT–BME 125/18 B $\frac{ZS}{22}$
< VDT–I–227/100 B >
Edition 3.1975
Translation of German
edition of 20.12.1974

When a component in the trigger box fails, particularly when travelling outside the Federal Republic of Germany, a replacement trigger box may not be immediately available.

In such a case, by taking the following emergency measure the vehicle can be made serviceable again until a replacement trigger box can be installed:

1. Withdraw connecting plug from the trigger box.
2. Connect pins 16 and 7 of the connecting plug together with a wire (see block diagram).
3. In making the connection make sure that the ignition capacitor of 0.2 µF is connected to terminal 1 of the ignition distributor.



1 = Battery
2 = Ignition lock
3 = Trigger box
4 = Resistor
5 = Ignition distributor
6 = Ignition coil
7 = To terminal 16 of starting motor

Block diagram showing emergency arrangement

The contact points of the ignition distributor are subject to considerable wear in this circuit and must be renewed when a new trigger box is installed. At the same time the dwell angle and the ignition point should be readjusted.

In case of inquiry, please contact your authorized representative.

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Kundendienstschule

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B18

INCORRECT DISPLAY OF ROTATIONAL SPEED AND DWELL ANGLE ONLY WITH TRIGGER BOXES 0 227 100 ... (TCI-i, TCI-h) WITH CURRENT LIMITATION

VDT-I-Gen. 030 En
6.80
Supersedes Ed. 3.80

For additional information see VDT-I-Gen. 032 En

1. General

In comparison with conventional ignition systems, transistorized ignition systems with current limitation have different primary voltage characteristics. During the dwell period the voltage at terminal 1 of the ignition coil may assume values from 1.5 V to battery voltage (or greater). This may lead to an incorrect display of rotational speed and dwell angle when testing the ignition system. However, there is no functional defect in the ignition system, and, for this reason, the trigger box must not be replaced. Incorrect displays may occur with the testers listed below:

MOT	001.00	Rotational-speed display O.K. with these testers	KTE	001.00
	001.01			001.02
	001.02			001.03
	001.04			
	002.00			

By now, the following vehicles may be fitted with breakerless ignition systems with current limitation:

Audi	(Bosch/Fairchild-ignition system)	Mazda	(Mitsubishi ignition system)
BMW	(Bosch ignition system)	Mitsubishi	(Mitsubishi ignition system)
Citroen	(Delco ignition system)	Nissan-Datsun	(Hitachi ignition system)
Fiat	(Delco ignition system)	Peugeot	(Bosch ignition system)
Ford	(Delco ignition system)	VW	(Bosch/Fairchild ignition system)
General-Motors	(HEI-ignition system)	Bosch transistorized ignition system for retrofitting 0 227 100 920	

2. Test instructions

2.1 Rotational speed

Incorrect rotational-speed display can be recognized as follows:

If one starts at the idle speed and slowly increases the engine speed, then the incorrect display can be recognized by an abrupt reduction in the rotational-speed display (e.g. from 2400 min^{-1} to 1200 min^{-1}).

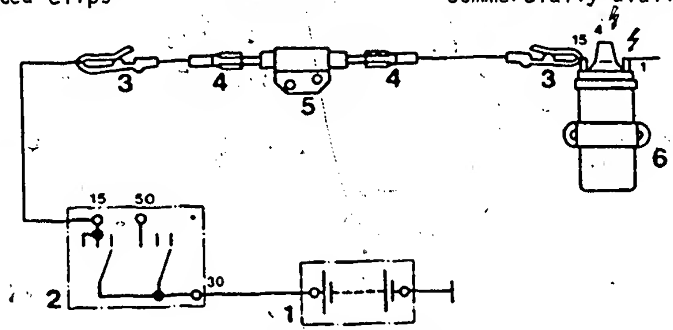
It is, however, possible to attain correct rot.-speed measurements as follows:

Connect a ballast resistor of 0.9 or 1.0 Ohm (see Fig.) in series in the line to term. 15 of the ignition coil (take care not to cause a short circuit). After the rotational-speed measurement, the ballast resistor must be removed (otherwise starting difficulties and misfiring). Connect tester as per operating instructions.

Suggestion for user manufacture

Required parts:

1 ballast resistor 0.9 Ohm	Part No. 0 227 900 002
or	
1 ballast resistor 1.0 Ohm	Part No. 0 227 900 101
2 blade receptacles e.g.	Part No. 1 901 355 881
approx. 0.2 m cable, 1.5 mm² e.g.	Part No. 6 210 150 150
2 insulated clips	Commercially available



1 = Battery
2 = Ignition switch
3 = Clips

4 = Blade receptacle
5 = Ballast resistor
6 = Ignition coil

approx. 400 V

approx. 25 kV

2.2 Dwell angle

The dwell angle is electronically controlled. A measurement of the dwell angle is no longer performed.

2.3 Ignition point

Is displayed correctly. Connect tester as per operating instructions.

MOTORTESTER CONVERSION
Incorrect display of rotational speed,
dwell angle and ignition point
only with trigger boxes
0 227 100 ... (TCI-i, TCI-h) with current
limitation

For additional information see VDT-I-Gen. 030 of 6.80

Re.: Motortester EFAW 268
268 S 10
269
214 B
AE 2000

1. General

Please make sure that the above-mentioned motortesters in your workshop and at your customers (e.g. motor vehicle workshops, oil companies, gas stations, vocational schools etc.) are converted. The conversion is subject to payment and is carried out by the K7 after-sales service of the responsible BG. The standard time is 15 work units (with fitting of switch).

2. Why motortester conversion?

In comparison with conventional ignition systems, transistorized ignition systems with current limitation have different primary voltage characteristics. During the dwell period the voltage at terminal 1 of the ignition coil may assume values from 1.5 V to battery voltage (or greater). This may lead to an incorrect display of rotational speed and dwell angle as well as to incorrect triggering of the meter when testing the ignition system. There is, however, no functional defect in the ignition system, and, for this reason, the trigger box must not be replaced. Since, with the above-listed motortesters, the timing light is triggered by the signal path dwell angle - meter, this incorrect triggering also leads to incorrect flashing and thus to an incorrect display of the advance angle.

3. Conversion measures

The situation is to be remedied by modifying the wiring of the testers so that the timing light is triggered by the clamp-on induction pickup and the pulse shaper stage.

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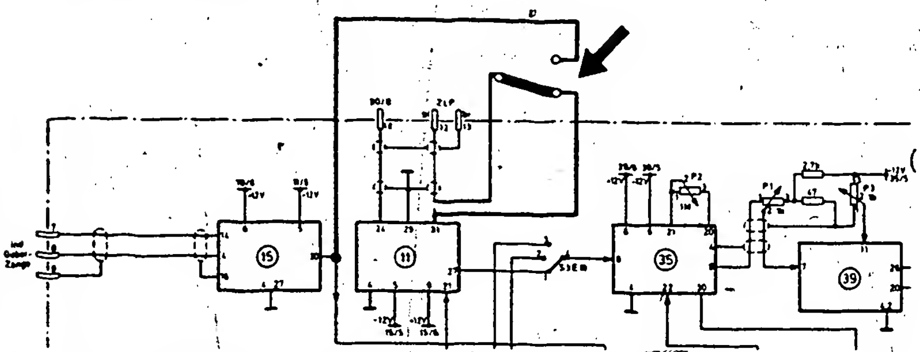
EFAW 268, 268 S 10, 269, AE 2000

Remove the line of the ZLP* from pin 31 of printed board 11 (coupling stage) and connect to pin 30 of printed board 15 (pulse shaper stage) via a switch with change-over contact (e.g. 0 341 500 803). In addition, a new line must be connected from pin 31 of printed board 11 to the other contact of the switch with change-over contact. Arrow points to switch with change-over contact.

* ZLP = timing light

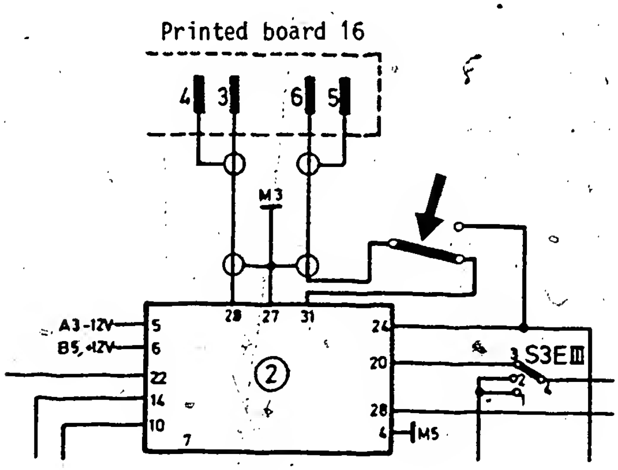


(Extract from WJF 508/1 Page 53)

ind. Geber-Zange = Clamp-on induction pickup

EFAW 214 B

Remove the line from terminal 6 of printed board 16 to pin 31 of printed board 2 (coupling stage) and connect to pin 24 of the same printed board via a switch with change-over contact (e.g. 0 341 500 803). In addition, a new line must be connected from pin 31 of printed board 2 to the other contact of the switch with change-over contact. Arrow points to switch with change-over contact.



(Extract from WJF 503/1, Page 64)

By fitting the switch with change-over contact in the front panel of the motor-tester, it is possible to switch over from standard ignition systems to those with current limitation. We recommend that the switch positions be marked correspondingly: e.g. "standard" - "current limitation".
These conversion measures have already been published in the K7 information sheet KJF 28/7911.

4. Test instructions

4.1 Standard ignition systems

Switch position: "standard"
All other tester connections as per operating instructions.

4.2 Ignition systems with current limitation

Switch position: "current limitation"

In order to trigger the timing light, the induction-type pulse generator (clamp-on pickup or red pickup) must always be connected during the measurement.

The selector switch for ignition systems built into the motortester must be switched to standard coil ignition (not to TCI) with these ignition systems.

All other tester connections as per operating instructions.

The dwell angle is electronically controlled. A measurement of the dwell angle is no longer performed.

TESTS ON ELECTRONIC IGNITION SYSTEMS (TCI, TZ) TESTER INSTRUCTIONS

The following tests are listed in older and current Tester operating instructions or in Trouble-shooting with the oscillograph.:

- "Separate ignition coil test" (concerns EFAW 213, 214, 268, AE 2000).
- Calculating the "ignition voltage reserve" (concerns EFAW 213, 214, 268, AE 2000 and MOT series).
- "Intensified insulation test" (concerns EFAW 213, 214, 268, AE 2000 and MOT series).

Nowadays transistorized ignition systems deliver more than 30,000 V secondary voltage.

To avoid damage to ignition coil, ignition cable and ignition distributor by voltage flashovers, the tests listed above should not be carried out on transistorized ignition systems.

The contents of this Service Information has already been published in the K7-Information K7-VJF 17/8012.

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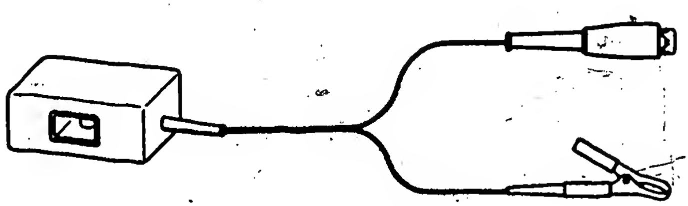
Register tab 5 Vehicles
File Identity VDT-I-KFZ 1001 En
05.1986

MEASURING THE PRIMARY VOLTAGE WITH PULSE SHAPER



Pulse shaper 1 684 463 154

In the case of modern ignition systems with rapid primary-voltage rise (e.g. TI, TCI, EI, fully-electronic ignition), the pulse shaper 1 684 463 154 is additionally required (see picture) for checking the primary voltage (Z-voltage) with MOT 201, 202 or 400. Without the pulse shaper, the readings will be incorrect.

Precise measuring of the primary voltage is specified in the SIS microcards (ignition). Therefore, always use the pulse shaper for this test.

The pulse shaper must be operated in accordance with the operating instructions.

The pulse shaper is not required for a functional test (evaluation of primary oscilloscope pattern).

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.

New Product

New Breakerless, Maintenance-Free Inductive Semiconductor Ignition System 0 227 100 90..

1. General

A breakerless, maintenance-free semiconductor ignition system has been developed for commercial sale, for retro-fitting in vehicles with 4-cylinder engines, in conjunction with the standard Bosch ignition distributor already installed in various vehicle models (in some cases since the 1972 model year).

The advantages offered by this system are:

- No contact-point wear – precise ignition point for years.
- Up to 40% more ignition voltage over the entire rotational-speed range.
- Reliable ignition even with sooted spark plugs.
- Improved starting in extreme heat or cold; as a result, less drain on the battery!
- Lower gasoline consumption.
- Lower emission of environmentally harmful exhaust gases.

Caution!

High-energy ignition system. Dangerous primary and secondary voltages.

Please take note of our technical bulletin VDT-I-227/102 B.

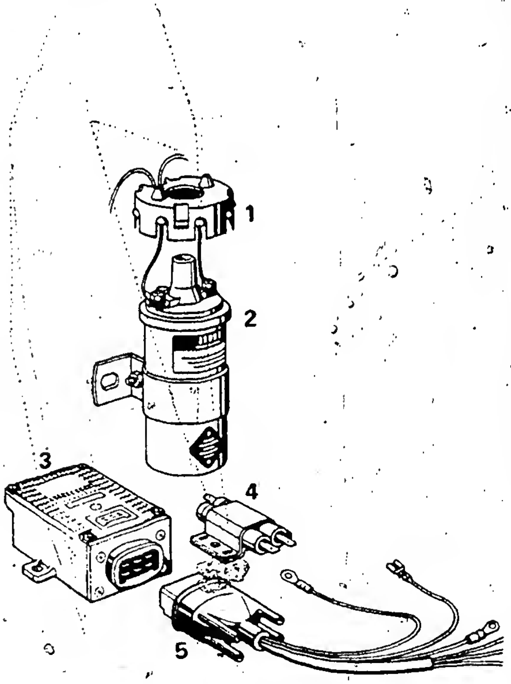


Fig. 1

1 = Protection against accidental contact
2 = Ignition coil
3 = Trigger box
4 = Ballast resistor
5 = Multiple plug

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Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.

B27

B27

2. Construction, Wiring Diagram

The system consists of the following parts:

1 trigger box	0 227 100 011
1 ignition coil KW 12 V	0 221 122 009
1 ballast resistor	0 227 900 102
1 set of pick-up parts	1 237 021 . . .

Complete conversion sets matched to the various vehicles and ignition distributors are given in the KH Information entitled "New Breakerless, Maintenance-Free inductive Semiconductor Ignition System".

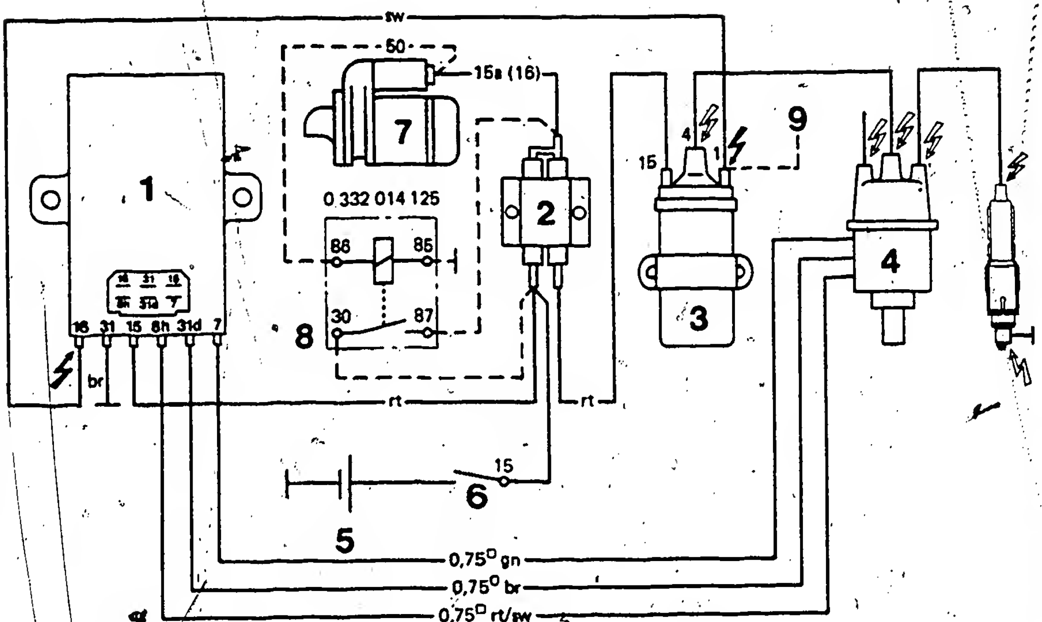

Fig. 2 Wiring diagram
(All cables not marked with □: 1.5 mm².)

1 = Trigger box
2 = Ballast resistor
3 = Ignition coil
4 = Ignition distributor
5 = Battery
6 = Ignition switch
7 = Starting motor
8 = Relay – Is connected only when the starting motor does not have a terminal 15a (16).
9 = To tachometer

about 400 V

about 25 kV

br = brown
gn = green
rt = red
sw = black

2.1 Ignition Coil, Ballast Resistor

Both parts are designed in the customary fashion. The ignition coil, however, has a special electrical construction and is fitted with a plastic accidental-contact protection shield.

2.2 Design of Trigger Box

The entire electronic system is enclosed in a cast, leak-proof aluminum housing sealed with an O-ring and with an aluminum cover. The housing has an opening sealed by the O-ring for the electrical connector. Heat developed by the power components (transistor, resistor) is dissipated through the housing to the vehicle chassis. The power transistor is mounted on the basin-shaped base of the housing and is encapsulated in casting resin.
The power resistor is pressed against the base of the housing by means of a spring. The assembly "printed board" contains the remaining electronic components and is fastened in the housing by three screws. The electrical connection is made by means of a 6-pin connector. Two self-tapping screws are used to fasten the trigger box to a flat section of the vehicle chassis.

2.3 Ignition Distributor 0 231 .. with Breakerless Hall Generator

In the standard breaker-triggered ignition distributor employed in the vehicle, a Hall generator designed for retro-fitting is used instead of the breaker contacts. The complete generator consists of a Hall ignition vane switch (Hall IC and magnetic circuit) together with a distributor rotor with trigger wheel.
For more detailed information please see VDT-I-231/1 B.

3. Description of Operation
(see also VDT-I-231/1 B)

An alnico permanent magnet installed in the ignition vane switch generates a magnetic field which is directed alternately either through the Hall IC, or past the Hall IC through vanes. The number of vanes equals the number of engine cylinders.
When a vane enters the air gap, the magnetic field is directed past (bypasses) the Hall IC, whose output is blocked.
When the vane leaves the air gap, the Hall IC output conducts, because the magnetic field now permeates the semiconductor layer.

When the Hall IC is blocked (vane in air gap), a control current flows through resistor R2 and the base of T1 which makes T1, and thus the Darlington output stage T2.1 and T2.2, conductive. As a result, a primary current can flow through the ignition coil located in the collector circuit of T2.1 and T2.2.

When the Hall IC conducts (vane outside air gap), T1 – and therefore also the Darlington output stage – is blocked. The primary current is thus interrupted. As a result of this interruption, a high voltage is induced in the secondary winding of the ignition coil, and this voltage is fed from the ignition distributor to the individual spark plugs in accordance with the firing sequence.

C3 and D5 are protective components for the output stage. R6, R8, C2, ZD2, and ZD3 serve to limit the voltage at the collector – emitter path in the Darlington circuit (collector-base clamp), i.e., these components constitute an overvoltage protection circuit (shunt) in parallel with the collector – base path.
C1, D1, D3, ZD1, and R1 serve to protect the Hall IC switch.

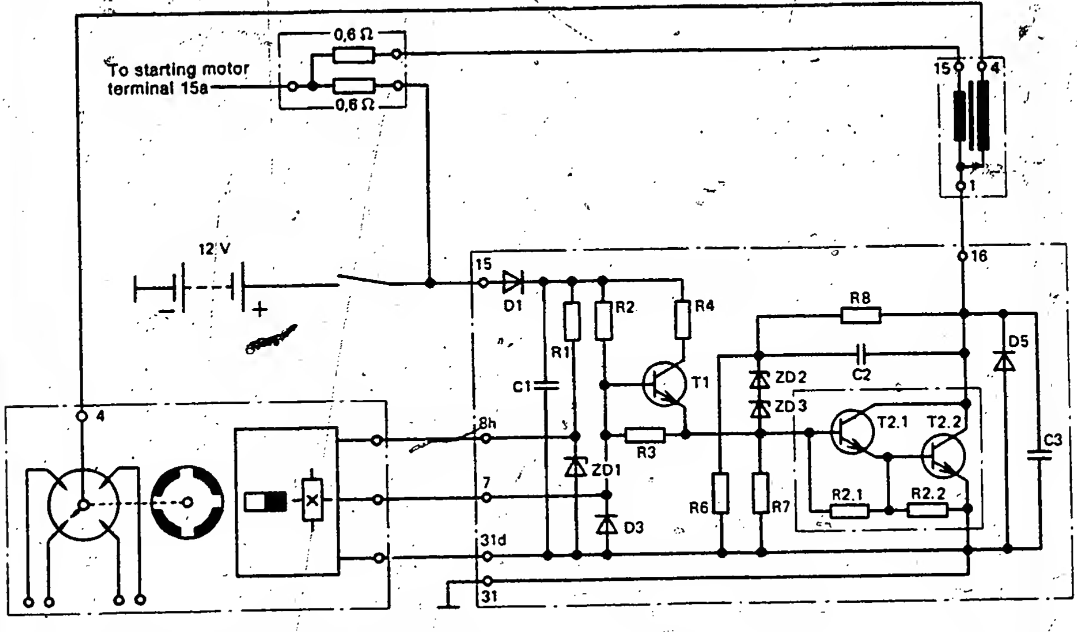

Fig. 3 Circuit diagram of the breakerless inductive semiconductor ignition system with internal circuitry of the trigger box

New Product

BREAKERLESS TRANSISTORIZED IGNITION SYSTEM (TCI-h)

VDT-I-227/5 En
9.1981
Supersedes Ed. 7.1981

Ignition triggering unit 0 232 102 001
Ignition coil 0 221 500 200

General

Newly introduced on this ignition system is a cast-resin-enclosed dual-circuit ignition coil and an ignition-triggering unit with Hall generator. For instance, as from 6.80, BMW motorcycles are equipped with this type of breakerless transistorized ignition system.

These ignition systems can be comprised of the following components:

Dual-spark cast-resin-enclosed ignition coil 0 221 500 200, ignition-triggering unit 0 232 102 001

- 0 with trigger box 0 227 100 103 with current limitation, for motorcycles with electric starter (i.e. BMW R 45, R 65, R 80)
- 0 with trigger box 0 227 100 113 with current limitation, for motorcycles with electric starter and kick-starter (i.e. BMW R 45, R 65, R 80)
- 0 with trigger box and ignition-triggering unit as above, but with 2 short-type bar ignition coils instead of the cast-resin-enclosed ignition coil. (Used, for instance, in the BMW R 100 motorcycle).

Trigger-box design

The trigger boxes 0 227 100 103/ .. 113 are of the already familiar design. With the trigger box 0 227 100 113 however, the peak-coil-current switch-off time has been increased from 1 s to 5 s due to the use in motorcycles equipped with a kick-starter as well.

Design of the dual-spark cast-resin-enclosed ignition coil 0 221 500 200

This ignition coil has an closed magnetic circuit consisting of 2 "L"-halves with a total air gap of 2 mm. The two "L"-halves are joined by straps and riveted to the mounting bracket. The straps and the mounting bracket are made from non-permeable material, otherwise the air gap would be short-circuited. The ignition coil is fastened to the vehicle by means of the mounting bracket.

The primary winding is wound in 2 layers on a plastic coil bobbin.

The two-part secondary winding is pushed over the primary winding. For reasons connected with production techniques, two identical secondary windings are used and these are connected in series. The complete primary and secondary winding assembly in then cast in artificial resin. Due to this hard plastic coating, the coil is insensitive to vibrational loading. The cast-resin-enclosed winding is fixed to the core by 2 leaf springs.

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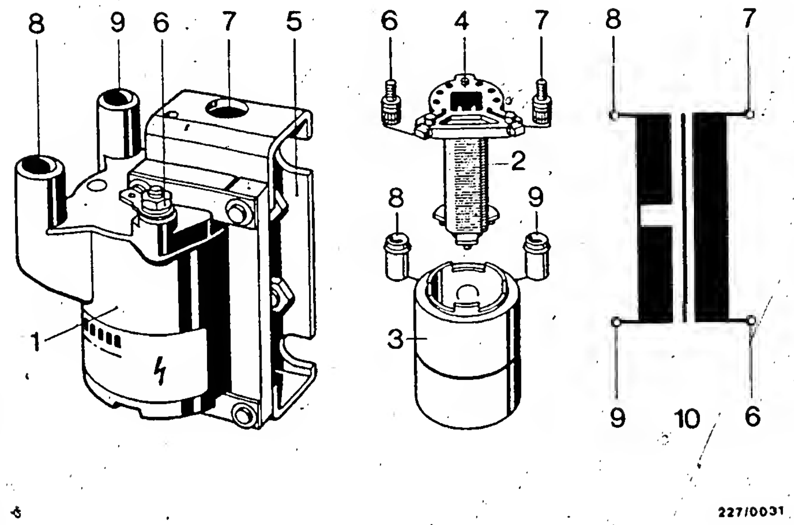
In contrast to the single-spark ignition coil, the primary and secondary windings of the dual-spark ignition coil are electrically insulated from each other. A high-voltage connection is attached to each end of the secondary winding. Due to its internal circuitry, the dual-spark ignition coil provides negative high voltage with respect to ground at terminal 4a, and at the same time positive at terminal 4b.



1 = Dual-spark ignition coil
2 = Primary winding
3 = Secondary winding
4 = Plastic coil bobbin
5 = Mounting bracket
6 = Term. 1 (-)
7 = Term. 15 (+) (hidden)
8 = Term. 4a
9 = Term. 4b
10 = Circuit diagram of the dual-spark ignition coil

Ignition coils with closed magnetic circuit are usually lighter and more compact than conventional rod coils.

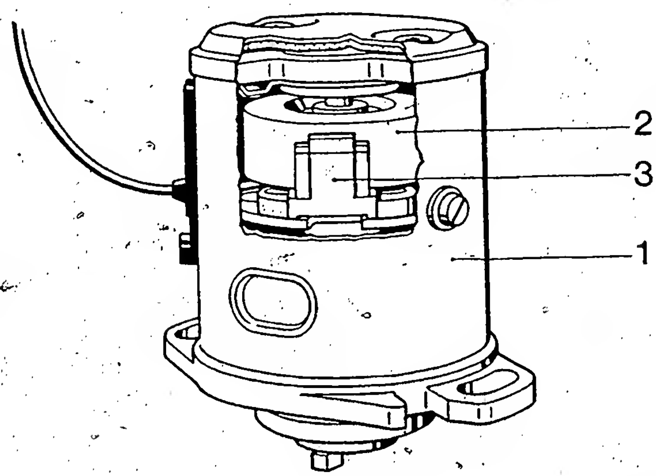
A further advantage of a dual-circuit ignition coil is that 2-cylinder engines can be operated without the need for rotating high-voltage distribution devices. In the case of a 4-cylinder engine, 2 such ignition coils would be necessary.

Design of the short-type rod ignition coil 0 221 100 313

This ignition coil is of conventional design. The vent plug usually fitted in the cover of this type of ignition coil is not necessary here because due to the low battery capacity and the two ignition coils connected in series the latter cannot burst even if the trigger box final stage should break down.

Design of the ignition triggering unit

The ignition triggering unit corresponds to a short-type ignition distributor as regards its method of mounting. A Hall generator is used as the pickup.



227/0032

1 = Cut-open view of ignition-triggering unit
2 = Rotor vane full in the ignition vane switch gap
3 = Ignition vane switch

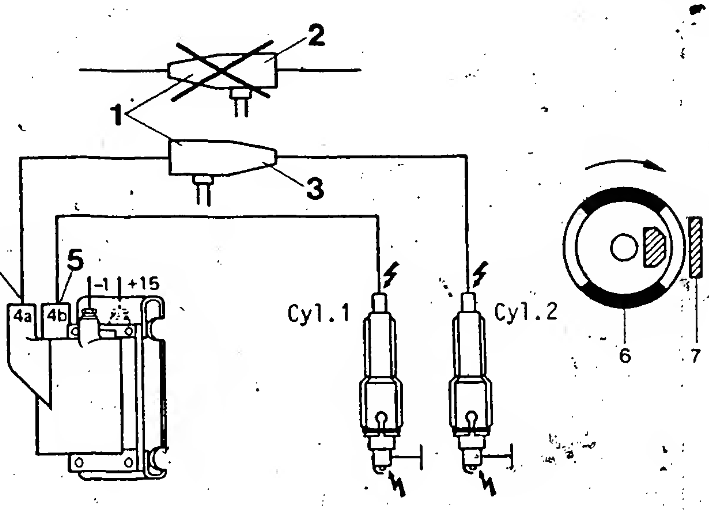
Notes for the workshop

Ignition timing adjustment with dual-spark cast-resin-enclosed ignition coils

As already mentioned, the dual-spark ignition coil always delivers a negative high voltage with respect to ground at term. 4a, and at the same time a positive high voltage from terminal 4b. For this reason, with ignition-point timing lights using an inductive pickup which is dependent upon direction of connection (red tubular pickup), the pickup must always be connected in line 4a with the pointed end towards the spark plug of cylinder 1 (see Fig.). Otherwise the ignition-point display will be incorrect.

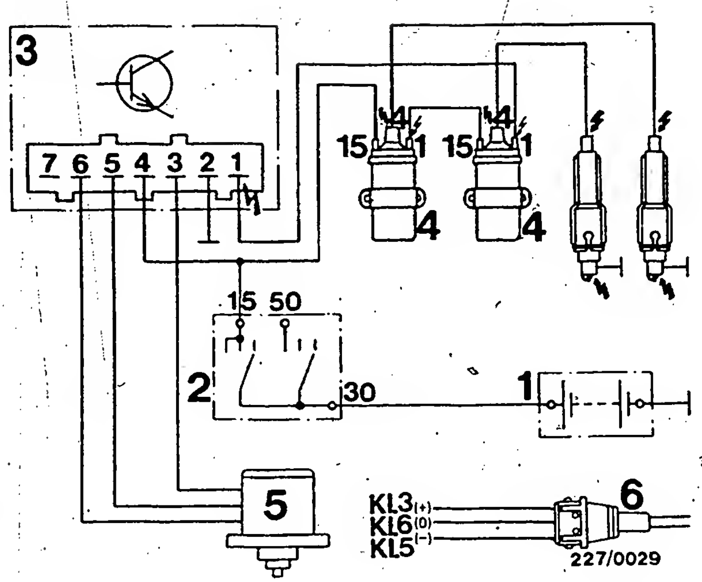
Ignition-point timing lights with clamp-on pick-ups are independent of direction of connection.

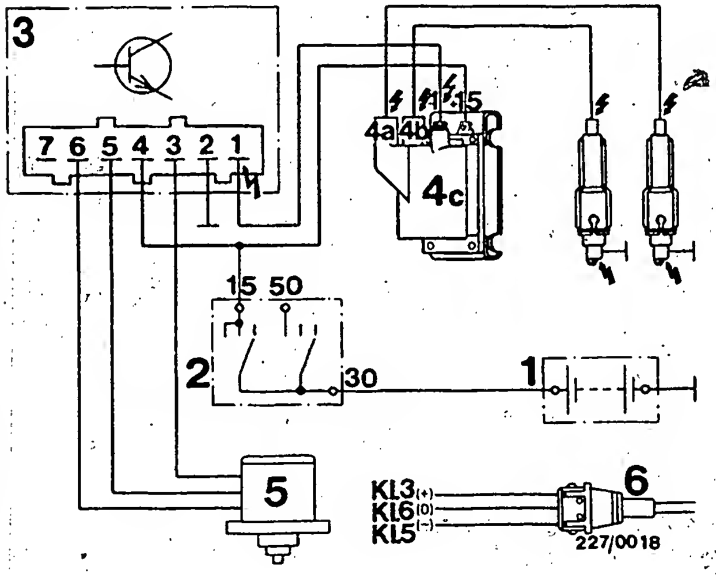
With ignition-point timing lights having a timing-advance meter, the displayed advance angle must be halved. Reason: Two ignition pulses are triggered for each revolution of the rotor vane. This means that ignition takes place both during the working stroke and the exhaust stroke. (4-stroke engine: the ignition triggering unit rotates at the same speed as the camshaft).



1 = Red tubular pickup from the timing light
2 = Connection incorrect
3 = Connection correct
4 = Negative high voltage
5 = Positive high voltage
6 = 2-cyl. rotor vane
7 = Ignition vane switch

Connection diagrams





Kl. = Term.

ϟ Dangerous voltages (400 - 25 kV)

1 = Battery
2 = Ignition-start switch
3 = Trigger box
4 = Ignition coil
4c = Dual-spark ignition coil
5 = Ignition-triggering unit
6 = Ignition-triggering unit - connection plug

Please note:

TCI-h trigger boxes in hybrid construction form can not yet be fitted into vehicles with L-Jetronic.

By means of the internal current limiting of the trigger boxes, impulses are created which enter the L-Jetronic control unit from terminal 1 of the ignition coil. Because of these additional impulses more fuel is injected than is necessary.

This means therefore: higher fuel consumption,
out-of-true engine running and
bad acceleration behaviour.

A new TCI-h of the conventional kind (without internal current limiting) with part no. 0 227 100 916 has therefore been delivered for vehicles with a 4 cyl. engine with L-Jetronic.

The supplementary-equipment set 0 227 100 916 is intended at first for the following vehicles:

Opel-Kadett C GT/E	1.9 l	} with ignition distributor 0 231 170 154 ... 235	
Opel-Kadett E GT/E	2.0 l		
Opel-Kadett Rally	2.0 l		
Opel-Manta GT/E	2.o l		
Opel-Rekord E	2.o l		
VW Beetle Automatic	1.6 l	with ignition distributor 0 231 170 044 ... 046 ... 048 ... 093	

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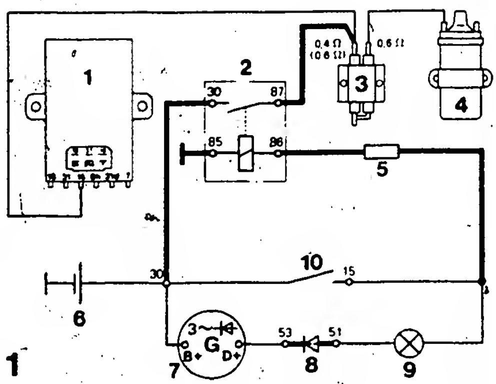
Vehicles with resistance cable

In vehicles with resistance cable between the ignition and start switch and the ignition coil terminal 15 (Fig. 1), the TCI-h can be connected by a make-contact relay which is controlled through the resistance cable, without a new cable being necessary.
With this wiring arrangement, running-on can occur.



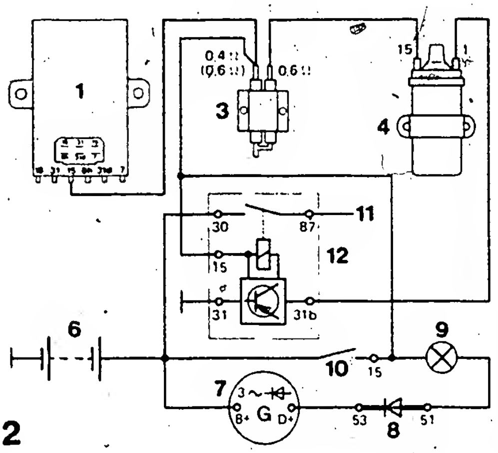
1

1 TCI-h trigger box
2 Make-contact relay
3 Ballast resistor
4 Ignition coil
5 Resistance cable
6 Battery
7 Generator/alternator
8 Diode 0 212 911 001
9 Generator/alternator control
10 Ignition and start switch
11 To fuel-pump circuit
12 Electronic relay
(non-Bosch product)

Vehicles with K-Jetronic

In vehicles with K-Jetronic an electronic relay (Fig. 2) is sometimes fitted by the manufacturer. If the ignition system is retrofitted with TCI-h, it is possible that this electronic relay does not release when the ignition has been switched off with the result that running-on occurs.

This difficulty does not arise in K-Jetronic systems with electromechanical relay



2

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Cause

When the ignition has been switched off by the ignition and start switch, a return voltage caused by the generator/alternator continuing to run-on occurs in cable 15 through the generator/alternator control.

The electromechanical relay, if wired via the resistance cable, cannot release when there is a sufficiently high return voltage present.

With the electronic relay in K-Jetronic systems, only a slight return voltage is necessary to prevent the relay from releasing.

Remedy

By fitting the diode 0 212 911 001 between generator/alternator terminal D+, or voltage regulator terminal D+/61, and the generator/alternator control, the return voltage from the generator/alternator is blocked and the relay can release.

If terminal D+ or D+/61 is connected for the control of auxiliary relays (for instance, for backlight defogger or similar devices), care must be taken that the control cables are connected between terminal D+ or D+/61 and the diode connection terminal 53, and NOT between diode connection terminal 51 and generator/alternator control.

After the TI-h supplementary set 0 227 100 920 has been fitted, cold-start and idling problems may occur (misfiring).

Reason: The dwell-angle control of the trigger box 0 227 100 103 reacts very quickly to irregular running of the engine, e.g. when cold-starting (revving up), with new engines which still have high friction, with vehicles which have automatic transmission, when one of the gears is selected whilst in idle.

Remedy: 1. Replace trigger box 0 227 100 103 with trigger box 0 227 100 118.

2. Fit an ignition coil 0 221 122 304 with FD after 049 (the date of manufacture must at all costs be checked).

Important: Ignition coils with date of manufacture up to FD 049 lead to misfiring if used together with trigger box 0 227 100 118.

Cost procedure:

Costs which are incurred can be covered by the usual guarantee (Guarantee class 7, fair deal).
The dismantled trigger box and ignition coil can be fitted in other vehicles (the trigger box is not defective), or they can be forwarded to K1/VAK for reimbursement, if a reference to this Service Information is enclosed.

Please note:

Supplementary sets 0 227 100 921 ... 924 are not affected by cold-start or idling problems.

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New Product

Breakerless Transistorized Ignition System

VDT-I-227/3 En
3.1979

Hybrid trigger box
0 227 100 100 for ignition distributor with Hall generator (TCI-h)
0 227 100 102 for ignition distributor with induction-type pulse generator (TCI-i)

1. General

Since 9. 78 the VW-Transporter Type 2 designed to meet Californian requirements has been fitted for the first time with a transistor trigger box (0 227 100 100) of hybrid design. Other vehicle manufacturers will follow suit in the foreseeable future.

These transistorized ignition systems feature the following:

- **Current limitation** makes it possible to dispense with ballast resistors and thus wiring and mountings, in addition to terminal 15 a (voltage increase for starting) in the starting-motor relay.
- **Dwell-angle control** significantly reduces the dependence on battery voltage, temperature and speed.
- **Peak-coil-current breaking** prevents the flow of primary current with the ignition switched on and the engine stationary.

2. Hybrid design

Hybrid design refers to the mounting of electrical components (e. g. resistors, diodes, transistors) in encapsulated or non-encapsulated form on a thick-film board (ceramic subtrate). In addition to being small and compact (see Fig. 1, Comparison of trigger box and spark plug sizes), the hybrid design has the advantage of reducing the number of junctions (e. g. soldered joints). This has a favourable effect on the reliability of the ignition system.

Caution!

High-energy ignition system. Dangerous primary and secondary voltages.

Please take note of our technical bulletin VDT-I-227/102 En

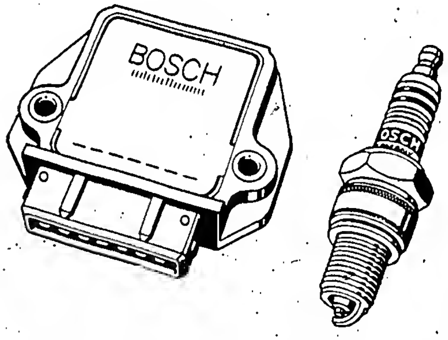

Fig. 1 Comparison of trigger box and spark plug sizes

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3. Construction

The system comprises the following:

Trigger box (for ignition distributor with Hall generator)	0 227 100 100
Ignition coil, e. g.	0 221 122 023
Ignition distributor with Hall generator	0 237 ...
or	
Trigger box (for ignition distributor with induction-type pulse generator)	0 227 100 102
Ignition coil, e. g.	0 221 122 029
Ignition distributor with induction-type pulse generator	0 237 ...

3.1 Trigger box design (see Figs. 2 ... 4)

The plastic trigger-box housing together with connecting part and moulded-in blade terminals form a unit. A metal base supports the circuit and at the same time dissipates heat. In order to prevent excessive heating of the hybrid circuit and power output stage, the latter is insulated and mounted on the metal base instead of on the ceramic substrate. The base is glued to the plastic housing.
The interior of the trigger box is lined with silica gel to protect the circuit from moisture and damage.
The trigger-box cover is glued in position. The trigger box is secured to the bodywork together with a special heat sink using a two-hole mount.
Particular attention should be paid to ensuring a flat, bright seating surface. The heat sink must be firmly bolted to the bodywork.

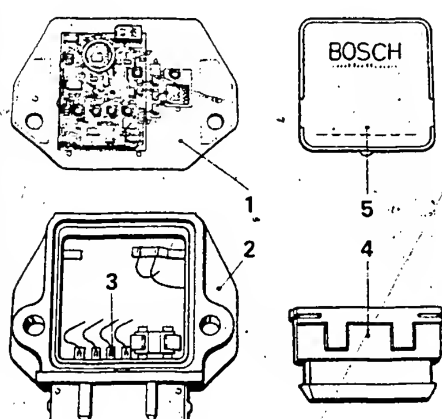


Fig. 2 1 = Metal base with thick-film board
2 = Trigger-box housing with connecting part
3 = Blade terminal
4 = Connector
5 = Cover

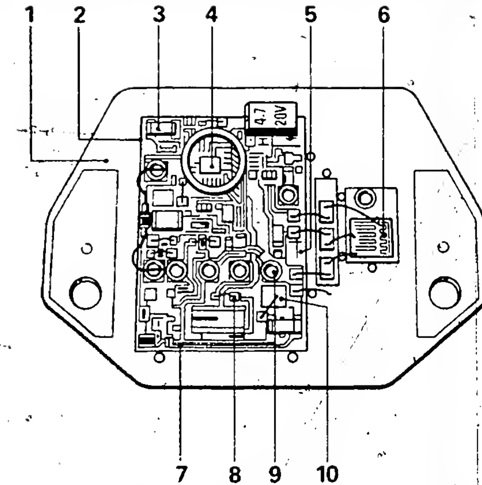


Fig. 3 1 = Metal base
2 = Thick-film board
3 = Capacitor chip
4 = IC for dwell-angle control and current limitation, as well as driver stage
5 = Precision resistor (current measuring)
6 = Transistor output stage
7 = Conductors
8 = Diode chip
9 = Contact points for connecting wires
10 = Zener-diode chip

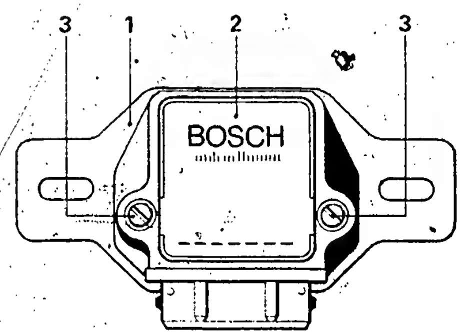


Fig. 4 1 = Heat sink for trigger box
2 = Trigger box
3 = Mount

3.2 Ignition coil

The ignition coil is of matched electrical design; apart from a few modifications, it is of well-known construction.
The cover of this ignition coil features a 5.5 mm opening with plug, which permits pressure compensation in the event of excess temperature (the plug works its way loose and prevents overpressure), see Fig. 5. Such a condition may be due to a defective trigger box (transistor output stage short-circuited, faulty peak coil-current breaking). In order to prevent the uncontrolled discharge of hot asphalt, the ignition-coil cover (plug) is provided with a cap, see Fig. 5.

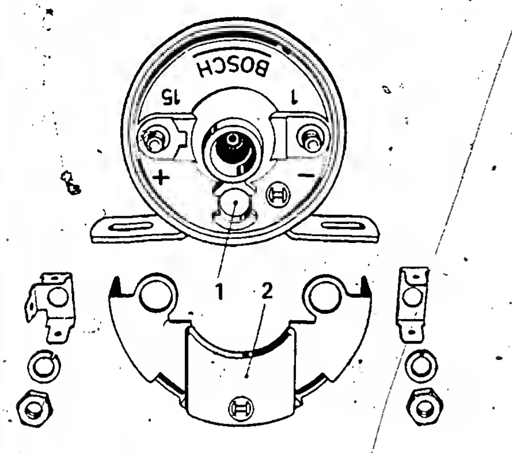


Fig. 5 1 = Plug
2 = Cap

3.3 Ignition distributor

Apart from a few modifications, the ignition distributors with Hall generator or induction-type pulse generator are of well-known construction.

For operation see VDT-I-231/1
VDT-BEE 121/1

4. Description of operation (see Figs. 6 ... 9)

4.1 Current limitation

Since there are no ballast resistors and unlike present-day transistorized ignition systems (switched output stage), the output stage also performs the function of current limitation. Consequently, use can be made of ignition coils with low-resistance primary winding **without ballast resistors.** The maximum primary current is no longer determined by the overall resistance of the primary circuit (ballast resistors + primary winding) but rather by the current limitation facility in the trigger box. The nominal primary current is specified by adjustment of the current limitation feature in the trigger box. In simplified terms, this feature operates as follows: a defined voltage drop occurs when the nominal primary current is reached at the current-measuring resistor (see block diagram 6). This voltage drop is sensed by the current limitation feature and causes the output stage resistor to operate in the same way as an electronically controlled ballast resistor. The decreasing voltage at the output stage resistor can therefore assume different values. In the case of present-day transistorized ignition systems – with switched output stage – the voltage drop at the conducting output stage transistor is approx. 1 to 2 V. In the case of the current-limited output stage the voltage drop amounts to approx. 6 to 8 V during the current-limiting time. During this time – after reaching the nominal primary current – the output stage transistor no longer operates in the saturation range.

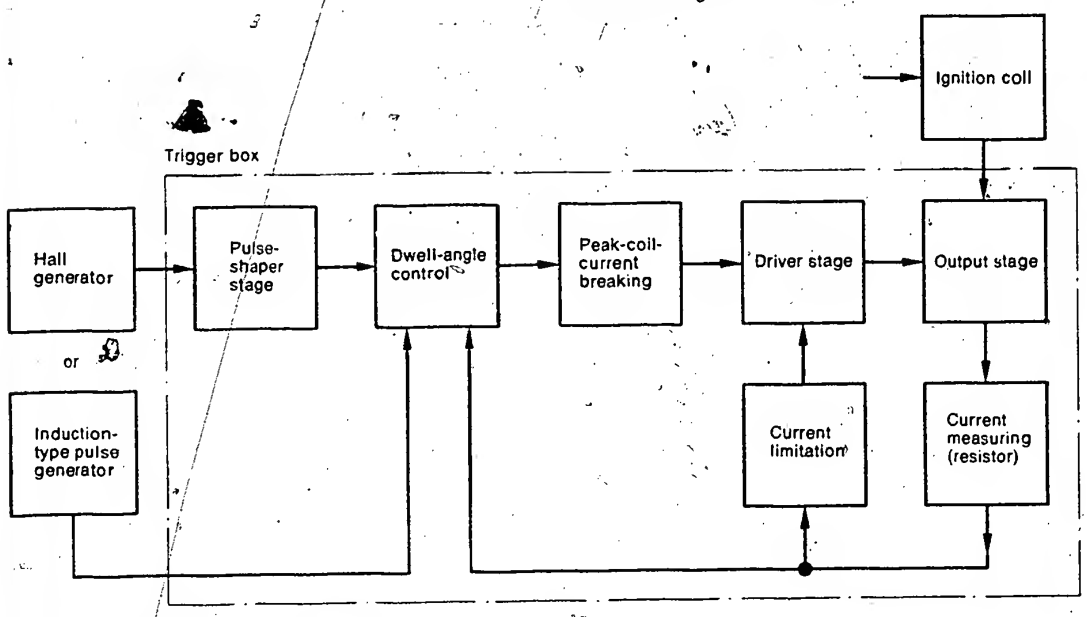


Fig. 6 Block diagram of trigger box with Hall generator or induction-type pulse generator

C13

1-22713
Seite 4

4.2 Dwell-angle control

As far as possible, the dwell angle is controlled such that the same primary-current level when switched off is always reached in all conditions, i. e. with different battery voltage, engine speed and temperature. This is clearly illustrated in Fig. 7. For instance, the primary-current curve is flatter at a battery voltage of 6 V (starting phase) than at 12 V or 15 V. This means that the primary current must be switched on, i. e. the dwell angle increased, considerably earlier in the case of 6 V than with 12 V or 15 V. In order to minimize the average power loss and thus heating up of the ignition system, the dwell angle is controlled with such precision that the current-limiting time in percent between the ignition points is short.
In the case of ignition distributors with **induction-type pulse generator** the dwell angle is modified by adjusting the trigger levels in the trigger box. The trigger making and breaking points move along the generator voltage curve. If the dwell angle is too small or too large, the trigger level assumes a more negative or positive value respectively, see Fig. 8.

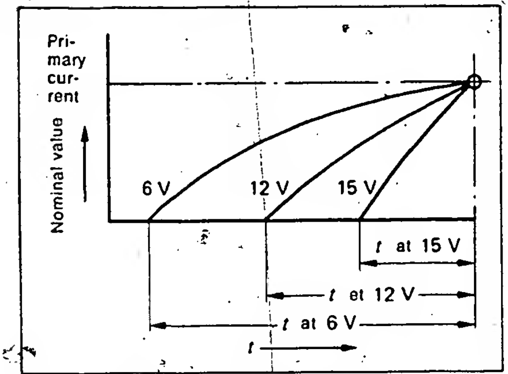


Fig. 7 Primary current curves with various U_B values

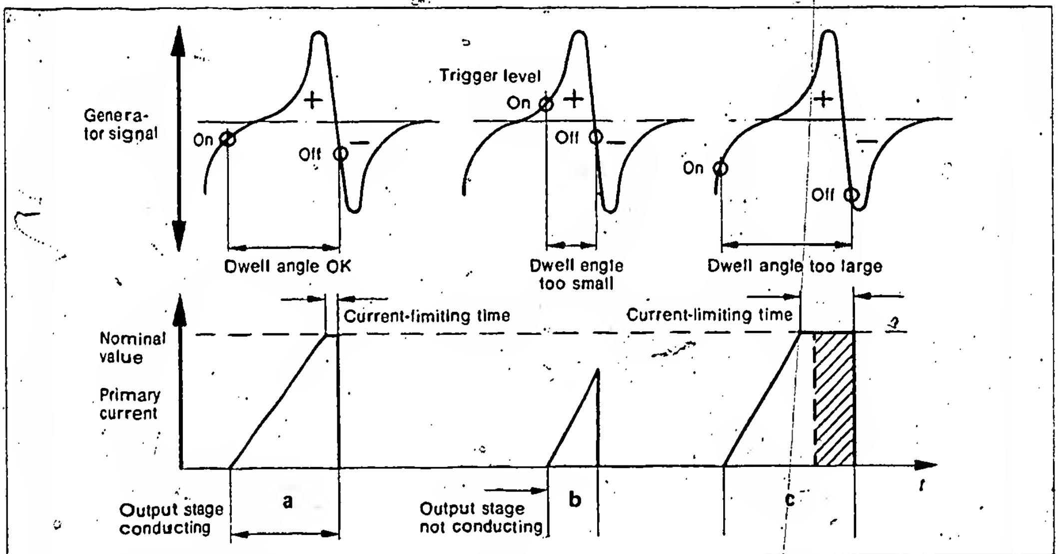


Fig. 8 Dwell-angle modification by adjusting trigger level in case of induction-type pulse generator

Explanations regarding a:
Primary current reaches nominal value and current-limiting time is not excessive.

Explanations regarding b:
Primary current does not reach nominal value, e. g. in case of high acceleration rate. Dwell-angle control causes the dwell angle to increase in the next cycle to such an extent that the nominal primary current is reached.

Explanations regarding c:
Primary current reaches nominal value but current-limiting time is too long, e. g. due to heavy engine deceleration. The dwell angle is reduced in the next cycle by the hatched area. Note: the hatched area is only converted into heat.

C14

In the case of ignition distributors with Hall generator a pulse-shaper stage must additionally be connected ahead of the trigger since there is no analog signal as in the case of the induction-type pulse generator. In the pulse-shaper stage the rectangular signal supplied by the Hall generator is converted into a triangle-wave ramp voltage. When the dwell angle is modified, the trigger levels move along the ramp voltage curve, see Fig. 9.

4.3 Peak-coil-current breaking

To prevent overloading of the ignition system with the engine stationary and ignition switched on, the transistor output stage is switched off electronically after max. 1 second. Ignition sparks are supplied once more immediately upon starting.

4.4 Driver stage

The driver stage with voltage limitation and interference suppression features corresponds to present-day transistorized ignition systems.

5. Warranty:

See Technical Bulletin VDT-I-227/103.

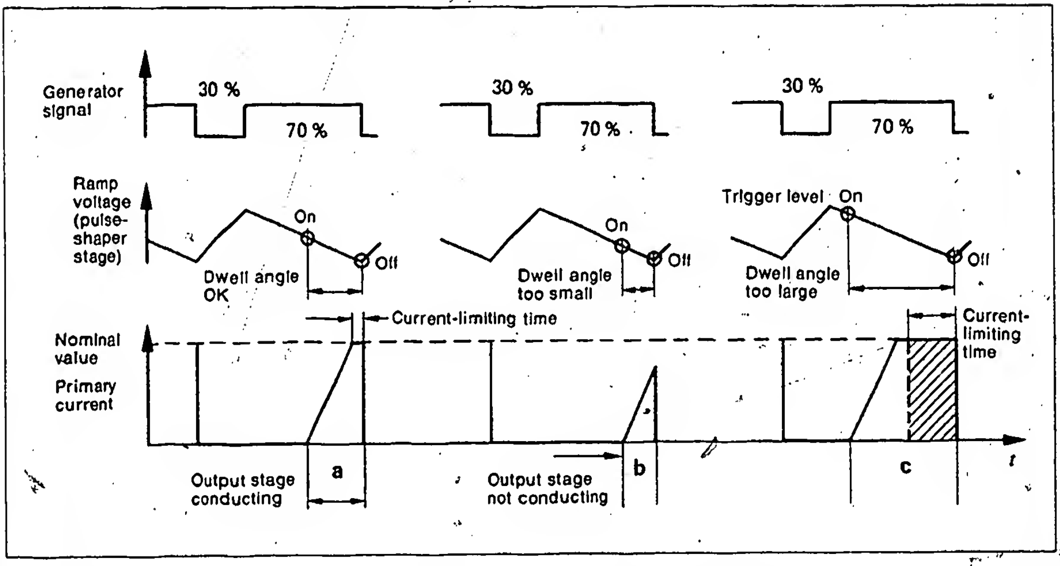


Fig. 9 Dwell-angle modification by adjusting trigger level in case of Hall generator

Explanations regarding a:
Primary current reaches nominal value and current-limiting time is not excessive.

Explanations regarding b:
Primary current does not reach nominal value, e. g. in case of high acceleration rate. Dwell-angle control causes the dwell angle to increase in the next cycle to such an extent that the nominal primary current is reached.

Explanations regarding c:
Primary current reaches nominal value but current-limiting time is too long, e. g. due to heavy engine decceleration. The dwell angle is reduced in the next cycle by the hatched area. Note: the hatched area is only converted into heat.

C15

New Product

BREAKERLESS TRANSISTORIZED IGNITION SYSTEM

Dual-component ignition systems

0 221 600 001 (TCI-h)
0 221 600 002 (TCI-i)

Caution!

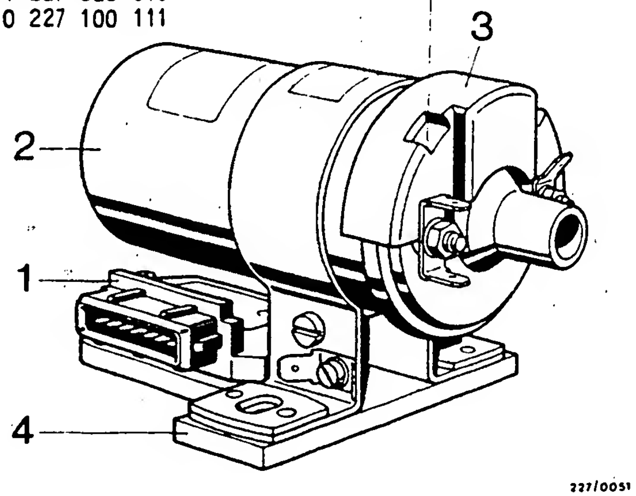
High-energy ignition system. Dangerous primary and secondary voltages.

Please take note of our technical bulletin VDT-I-227/102 En.

Alfa-Romeo vehicles (as from 2.81) and Opel vehicles (as from 7.81) are being fitted with a dual-component ignition system (ignition coil and trigger box on a common heat sink).

The TCI-i installation 0 221 600 002 for Alfa-Romeo vehicles comprises

Ignition coil   1 227 020 010
Trigger box   0 227 100 111



1 = TCI-i trigger box
2 = Ignition coil
3 = Protective cap
4 = Heat sink

BOSCH
Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.
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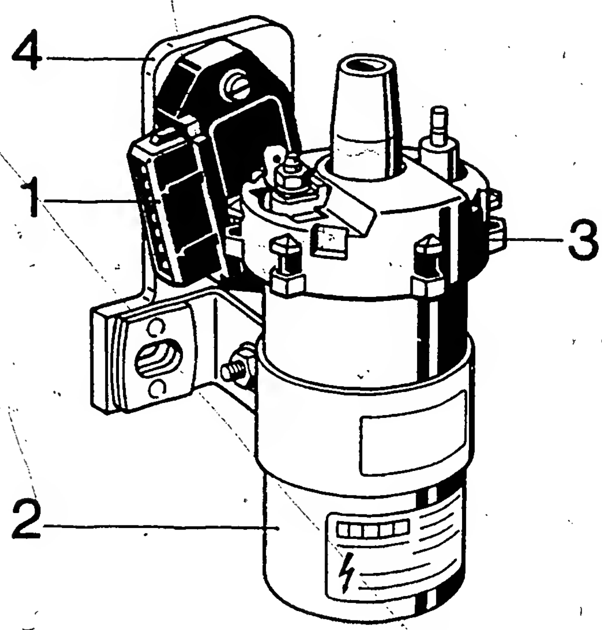
C16

The TCI-h installation 0 221 600 001 for Opel vehicles comprises

Trigger box 1 227 022 008
Ignition coil 1 227 020 009



1 = TCI-h trigger box
2 = Ignition coil
3 = Protective cap
4 = Heat sink

Description of function

The functioning of the installations (TCI-h, TCI-i) has already been described in VDT-I-227/3. The only difference being that the peak-coil-current cut-off facility is omitted in the trigger box 0 227 100 111.

Notes for workshop

The trouble-shooting instructions for the Alfa Romeo and Opel vehicles are in the course of preparation.

SERVICE PARTS FOR TCI-h AND TCI-i
with trigger boxes in hybrid form
Trigger box 0 227 100 1..

VDT-I-227/105 En
7.1980

For service part needs the 7-pole plug and socket is now available as a parts set with part no.:

2 227 000 111

consisting of:

1 plug housing
1 protective cap
7 contact springs

The contact springs can also be ordered separately under part no. 1 284 477 026.

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.

BREAKERLESS TRANSISTORIZED IGNITION SYSTEM (TCI-i)

Hybrid design trigger box 1 227 022 003 (with current limitation) fitted to ignition distributor with inductive-type pulse generator (TCI-i).

Caution!

High-energy ignition system. Dangerous primary and secondary voltages.

Please take note of our technical bulletin VDT-I-227/102 En

General

As from October 1980, the first 2-component ignition system is to be fitted in the Ford Escort (1.3 and 1.6 l Hemi engine)

The trigger box is fitted to the ignition distributor. Fig. 1

Construction

The system comprises:

Ignition distributor	0 237 600 ...
Trigger box	1 227 022 003
Ignition coil	0 221 122 031

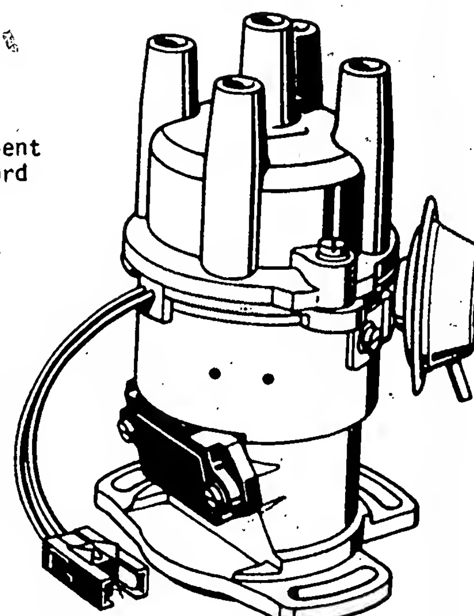


Fig. 1
2-component ignition system

BOSCH
Geschäftsbereich Kfz. Kundendienst, Kfz-Ausrüstung.

Ignition distributor

The ignition distributor is fitted axially on the rear of the cylinder head by means of a flange. The method of fastening is the same as for the shortened version.

The distributor is driven from the camshaft by means of a claw coupling. The induction-type pulse generator is equipped with pointed teeth and is constructed of sintered-metal material. Fig. 2.

Trigger box

Compared to the trigger-box model described in VDT-I-227/3 En and its function and operation, the trigger box used here (1 227 022 003) has its blade terminals exposed and not surrounded by a plug housing. Fig. 3.
There is no peak-coil-current present at the trigger box, and therefore the peak-coil-current switch-off device is omitted.

Ignition coil

The ignition coil is of matched electrical design (ignition coil is matched to the trigger box electrically) and is of conventional design as described in VDT-I-227/3 En.

Workshop notes

In order to replace the trigger box the distributor must be removed.
For reasons of good heat dissipation, the base plate of the trigger box must be coated (Fig. 3) with heat conductivity paste before fitting to the distributor. Part number of paste: 5 942 860 030.

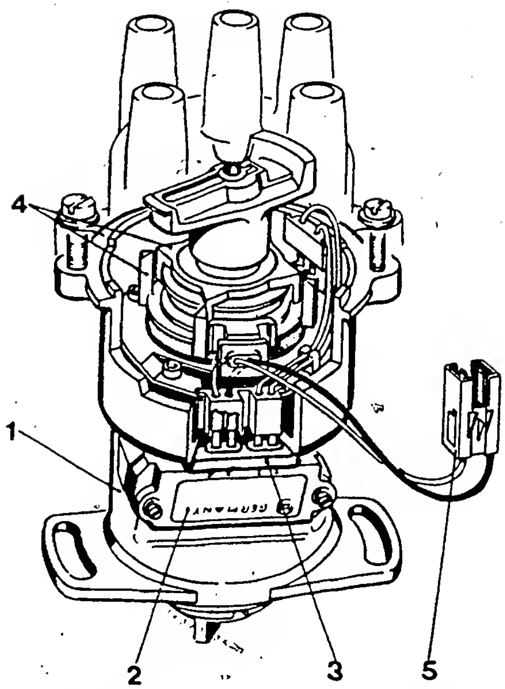


Fig. 2 1 = Ignition distributor
2 = Trigger box
3 = Rubber gasket
4 = Inductive-type pulse generator
5 = Plug

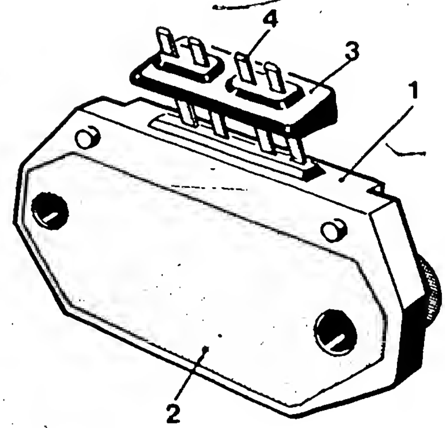


Fig. 3 1 = Trigger box
2 = Base plate
3 = Rubber gasket
4 = Blade terminal

Kundendienst KH
Technische Mitteilung

KE

024..
Tightening torques for spark plugs

VDT-BME 141/50 B 24
1st Supplement
<VDT-I-240/100 B>
Edition 9.1974
Translation of German edition of 28.8.1974

In Technical Information Sheet (Technische Mitteilung) BME 141/50 B KE one of the things mentioned with regard to over-tightened spark plugs is the gasket thickness. The previously given gasket thickness comparison table is no longer valid after general introduction of the 3-layer gasket, since the deformation range is too small.

An over-tightened spark plug can be recognised by an unsealed, loose insulator or broken shell on the run-out of thread. Pressure marks on the sides of the hexagon are often a further sign of over-tightening. Over-tightened plugs do not constitute a case of warranty.

In order to avoid difficulties of this nature, we recommend that the following, somewhat extended chart of tightening torques (in N.m) be adhered to:

Plug thread	M 10x1	M 12x1.5	M 14x1.25	M 14x1.25 conical seat	M 18x1.5	M 18x1.5 conical seat
in cast iron	10...20	15...25	20...35	15...25	30...45	15...30
in light metal	8...15	12...20	15...30	12...20	20...35	15...23

Note: $\approx$ 10 N.m = 1 kgf.m or 1 kgf.m = 9.81 N.m

The tightening torques apply only to new spark plugs which have been lightly oiled at the works. A special lubrication of the thread (with e.g. graphited grease or similar) is not necessary for the nickel plated surface of our plugs. If lubrication is carried out despite this, the maximum tightening torque should be reduced by one-third.

It is easy to differentiate between plug shells with a broken heat-shrunk seal and over-tightened plugs. The former do not occur on the run-out of thread, but on the shell seal directly below the hexagon. Such plug defects can be treated as a warranty case and can be notified, or sent, together with the defective plugs and the warranty documents, to your authorized representative. This also applies to any applications which are made for refund of costs arising from such cases.

ROBERT BOSCH GMBH
Geschäftsbereich K1
Abteilung VAK 6

0 24 . .
Spark-plug Faces

VDT-I-240/101 B
4. 1976

You have already been informed in detail about the construction and functioning of spark plugs (VDT-UBE 140/4 B).

In the sales documentation, the spark plug recommendations originate from Bosch if they are not from the vehicle or engine manufacturers themselves.

The customer expects the specialist to be able to give him expert advice on his spark plug problems. The spark-plug face can show quite clearly what is going on inside the combustion chamber.

The following pages contain a series of illustrations with text and show typical spark-plug faces.

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Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.

1

2

3

Fig. 1: Normal condition

Insulator nose grayish-white or grayish-yellow to brown. Engine is in order Heat range of plug correct.

Fig. 2: Sooted – carbon-fouled

Insulator nose, electrodes and spark-plug shell covered with velvet-like dull black soot deposits.

Causes
Carburettor setting, mixture too rich
Air-filter element very dirty
Automatic choke not in order
Manual choke pulled too long
Extreme stop-and-go city driving, with
Too much driving at low engine revs and
Too many traffic-light stops
Spark-plug heat range possibly too high

Effect
Danger of shunts* (cold shunt) particularly during cold-start with fuel enrichment.

Remedies
Correct carburettor and automatic choke adjustments, clean air filter; accelerate engine slowly up to full-load. If this does not help, try using spark plugs with the next lower heat range.

Please note:
If engine runs too long at idle speed before spark plug removal, the spark-plug face can also appear sooted (especially if the engine has not reached operating temperature).

Fig. 3: Oil-fouled

Insulator nose, electrodes and spark-plug shell covered with wet, shiny oil carbon and soot deposits.

Causes
Too much oil in the combustion chamber.
In two-stroke engines too much oil in mixture.
Badly worn cylinders, piston rings and valve guides.

Remedies
Correct mixture ratio, overhaul engine, fit new spark plugs.

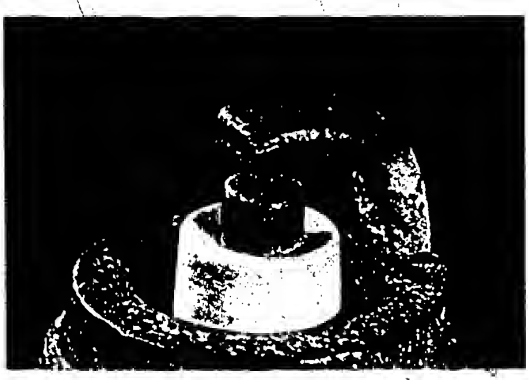
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Fig. 4: Slight lead deposit

Dull-yellow insulator deposits. Insulator nose covered with bright yellow, silky-dull to shiny deposits.

Causes
Anti-knock additives in the fuel such as the metal-organic compounds tetraethyl lead (TEL) and tetramethyl lead (TML).

Effect
At high insulator nose temperatures the lead deposits become electrically conductive and lead to shunts*: This is noticeable in the vehicle at higher speeds. The experts call this a warm shunt.

Remedy
Fit new spark plugs. Spark-plug cleaning (by sand-blasting or brushing) is useless.

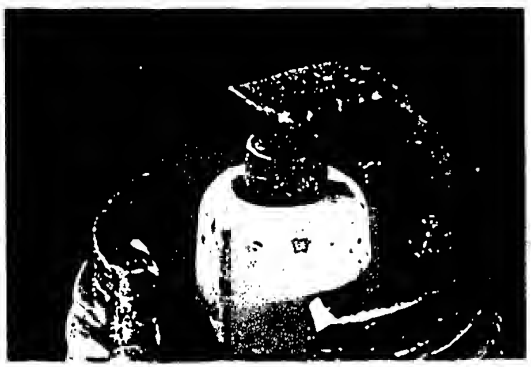
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Fig. 5: Heavy lead deposit – thick yellow-glazed insulator deposits

The insulator is evenly glazed with a thick yellow deposit which is solidly bonded with the insulator nose.

Cause
The deposit is due to lead additives in the fuel.

Effect
Shunt* (warm shunt).

Remedy
Cleaning and sand-blasting useless – fit new spark plugs.


6

Figs. 6, 7: Heavy lead deposit – yellow-glazed insulator deposits, which can also be greenish in places

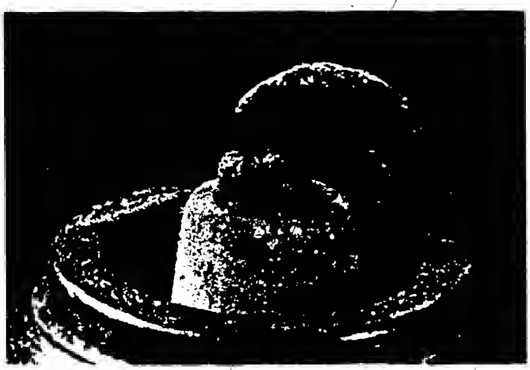
In places, the insulator nose is glazed brownish-yellow. The deposit is solidly bonded with the insulator nose.

Cause
Fuel additives.

Effect
The glaze indicates melting of deposits under heavy engine stress; the result is a shunt* (warm shunt).

Remedy
Cleaning and sand-blasting useless.
The spark plugs must be replaced.


7



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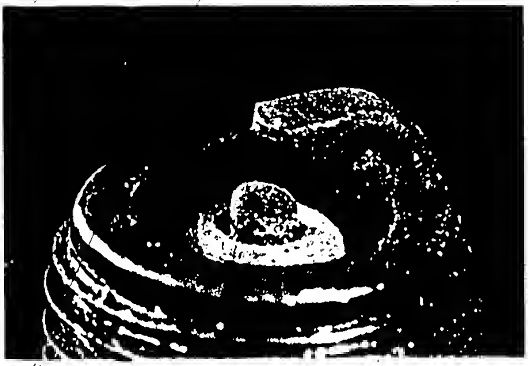

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Fig. 8: Heavily corroded electrodes

Causes
Heavy corrosion caused by aggressive fuel and oil additives.
Unfavorable influences of gas turbulence in the combustion chamber, possibly caused by deposits therein.

Effect
Jerky behaviour due to misfiring (particularly during acceleration), since voltage required for ignition is too high due to excessive electrode gap. Engine is difficult to start.

Remedy
Fit new spark plugs. If necessary, change from a spark plug with projected insulator nose to a normal type.

Please note:
The spark plug was not thermally overloaded, therefore this is not a heat range problem.

Fig. 9: Heavy electrode erosion

Causes
Natural wear-and-tear, recommended interval between spark-plug changes not complied with.

Effect
Jerky behaviour due to misfiring (particularly during acceleration), since voltage required for ignition is too high due to excessive electrode gap. Engine is difficult to start.

Remedy
New spark plugs.

- **Shunt**
  The ignition voltage is dissipated away across electrically conductive deposits on the insulator nose and this leads to misfiring.

  Cold shunt
  Cause: Sooted, oil-fouled or wet insulator nose.
  Effect: Cold-start difficulties, uneven engine running during the warm-up period, misfiring during acceleration in the lower rotational-speed range.

  Warm shunt
  Cause: Fuel and oil additives (lead content) which settle on the tip of the insulator nose as electrically conductive deposits.
  Effect: Misfiring in the middle and upper rotational-speed ranges.

10

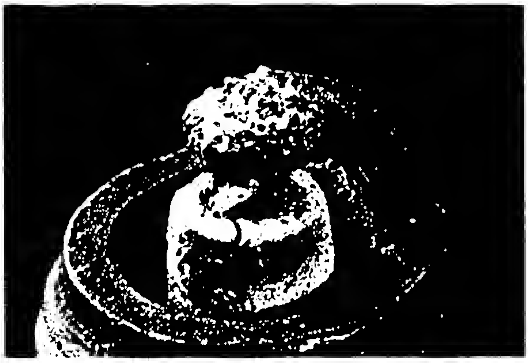
Figs. 10, 11, 12:
Thermally overloaded spark plugs

Fig. 10: Partially melted center electrode, blistered, spongy, soft insulator nose tip.

Cause
Preignition**, e.g. heat range too low.

Effect
Misfiring, power loss.

Remedy
Check engine, particularly ignition system and mixture formation.
Fit new spark plugs with the correct heat range.



11

Fig. 11: Center electrode completely melted away, insulator nose cracked.

Cause
Abnormal combustion processes, for example fuel knocking, preignition** due to ignition being advanced too far.
Expansion of the overheated center electrode can result in the insulator cracking.

Effect
Misfiring, power loss, engine damage.

Remedy
Check engine, particularly ignition system and mixture formation.
Fit new spark plugs with the correct heat range.

12

Fig. 12: Partially melted electrodes, deposits of piston material.

Cause
Preignition**, particularly due to ignition being advanced too far, combustion deposits in combustion chamber, defective valves, mixture too lean, defective ignition distributor, incorrect spark plug heat range.

Effect
Power loss, often engine damage.

Remedy
Check engine, particularly ignition system and mixture formation.
Fit new spark plugs with the correct heat range.

** **Preignition**
is the term given to uncontrolled combustion beginning, independently of the ignition system, before the firing point.

13

Fig. 13: Ash – from oil and fuel additives

Heavy ash deposits on the insulator nose, in the scavenging area and on the ground electrode. The structure of the ash is loose to cinder-like.

Causes
Alloying constituents from oil and fuel leave an incombustible ash in the combustion chamber (piston head, valves, cylinder head) and on the spark-plug face.

Effect
Can lead to preignition** with resultant power loss thus causing engine damage.

Remedy
Repair engine. Fit new spark plugs.

14

Fig. 14: Insulator nose breakage

Cause
Mechanical damage due to being struck or dropped, or to pressure on the center electrode resulting from incorrect methods of setting the electrode gap, e.g. bending the ground electrode with a screwdriver,
or
corrosion of the center electrode due to aggressive fuel additives, which may cause the insulator nose to crack and break,
or
deposits between center electrode and insulator nose occurring when the spark plug has been in use for too long.

Effect
Misfiring – the spark plug shunts between insulator and shell, damage to the engine cannot be ruled out.

Remedy
Check engine. Fit new spark plugs.

INSTALLATION INSTRUCTIONS FOR SPARK PLUGS OF TYPES F AND H

VDT-I-240/102 En

0 24 ..

11.1985

supersedes Ed. 05.1985

Both German and non-German manufacturers are increasingly developing new engines which are equipped as standard with F or H type spark plugs (A/F 16 mm = 5/8").

To prevent damage to cylinder heads due to overstressed spark-plug seats, the following tightening torques must be observed under all circumstances when changing spark plugs:

10 to 20 Nm for type H
20 to 30 Nm for type F

We therefore recommend that spark plugs be tightened with a torque wrench and that installation tools be used with which it is not possible to exert any lateral pressure on the insulator.

Such tools are offered by many manufacturers.

Technical Bulletin

BOSCH
Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung.

IMPORTANT:

To protect the spark plug ceramic, always ensure that the spark-plug wrench of whatever kind is not tilted or slanting when applied. In this way, you will prevent insulator breakages which make spark plugs unserviceable or cause shunts.

Please pass on this information to your employees who are involved in your workshop with the installation of spark plugs.

Published by:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Initiated by: K1/VAK 2

DIFFERENT SPARK-PLUG RECOMMENDATIONS - VEHICLE MANUFACTURER TO BOSCH

The correct spark plug for each type of vehicle or engine is ascertained as a rule by the vehicle manufacturer or by Bosch by means of extensive driving and measuring tests.

The Bosch spark-plug catalog is based on these facts.

However, it sometimes happens that when the spark-plug catalog is not used correctly, a spark plug with e.g. a different heat rating is fitted because the Bosch spark plug was determined by menas of the cross-reference spark plug list non-Bosch to Bosch.

In order to avoid such misunderstandings, we would ask you to observe the following:

. The spark-plug recommendation for the vehicle or the engine is decisive in ascertaining the correct spark plug for the vehicle or the engine.

. Secondly, when there is no vehicle-related cross-reference list for spark plugs, the spark-plug cross-reference list non-Bosch to Bosch can then be used.

. In vehicles in which the after-sales service center finds non-Bosch spark plugs which do not correspond with the Bosch vehicle recommendations according to the cross-reference non-Bosch to Bosch, the service center must ascertain, before changing to another heat rating, whether or not the non-Bosch spark plug they have found is approved of by the vehicle manufacturer for the relevant vehicle. In such cases one cannot argue that the customer is "driving with the wrong spark plug." If necessary, in the case of spark plugs which are too cold and which are dirty, the warmer Bosch spark plug approved of by us or by the vehicle manufacturer can be offered or recommended as a solution to the problem.

In cases of doubt please contact your relevant RG/AV.

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Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

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D3

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D5

PLATINUM SPARK PLUGS — VDT-I-241/106 En

Judgement, warranty procedure — 2.1985

With effect from the publication of this Technical Bulletin, platinum spark plugs which are the subject of a complaint are only to be sent in when it is your opinion that a manufacturing or material fault is the cause of the complaint.

Pointers on the assessment of platinum spark plugs which are the subjects of complaint can be taken from the Technical Bulletin VDT-I-241/105 En, dated 5.1984, which is still valid regarding technical points.

Pointers regarding warranty procedure are to be taken from the Warranty Handbook WAA 051/5-07.

After publication of this Technical Bulletin, platinum spark plugs which are sent in without defect or other valid reason to Dept. K1/VAK will no longer be examined. The reimbursements in such cases, as well as the costs granted up to now for registration purposes, are no longer in force. Such spark plugs must be recalled by the sender before they are returned (not prepaid).

Worn-out spark plugs are not covered by warranty.

Please direct inquiries and comments concerning the contents to our authorized representative in your country

Technical Bulletin

BOSCH
Geschäftsbereich KH, Kundendienst Kraftfahrzeug-Ausrüstung.

D6

Register 13...39
File Identity VDT-I-241/107 En

ELECTRODE GAPS, WEAR

ASSESSMENT ON BOSCH SPARK PLUGS

10.1986

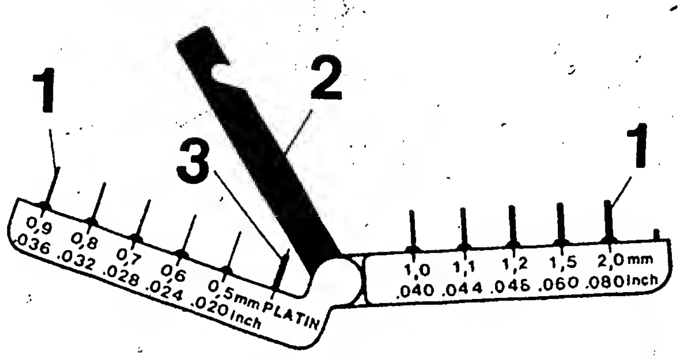
Replaces edition of 08.1985

1. Electrode gap

The Bosch firm offers in its sales program the most common electrode gaps for each type of spark plug.

However, engine manufacturers may specify differing electrode gaps. If a spark-plug version is desired with an electrode gap which is not part of the BOSCH line or is not in stock, the electrode gap can be adjusted with the

Bosch spark-plug gap gauge
Part no. 0 986 600 000.

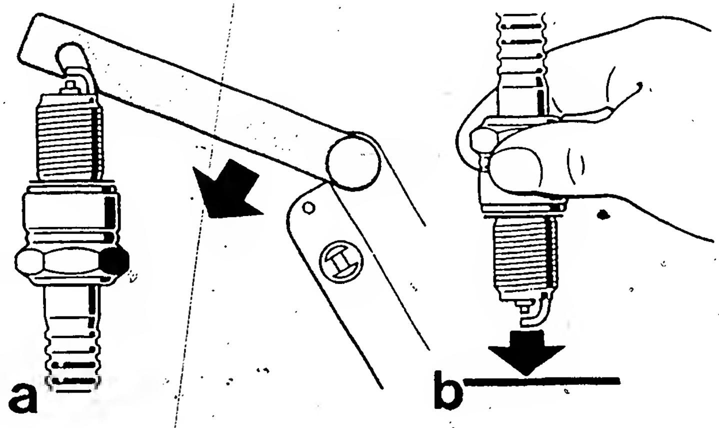


1 = Gauge wires for electrode gap

2 = Bending lever for increasing electrode gap

3 = Gauge wire for platinum spark plugs (for testing the wear limit)

Seite 8



Increasing electrode gap

Bend up ground electrode with bending lever (see figure a).

Reducing electrode gap

Knock spark plug (ground electrode) against suitable surface (e.g. vise) (see illustration b).

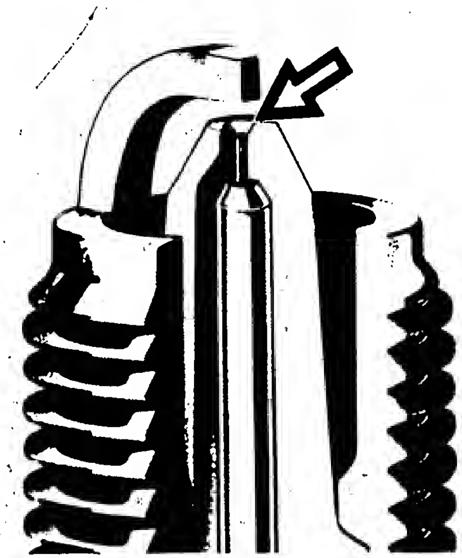
Seite 4

2. Assessing wear of Bosch platinum spark plugs

Like our other spark plugs, the Bosch platinum spark plug is designed so that the exchange intervals prescribed by the engine manufacturer can be easily reached without readjusting the electrode gap.

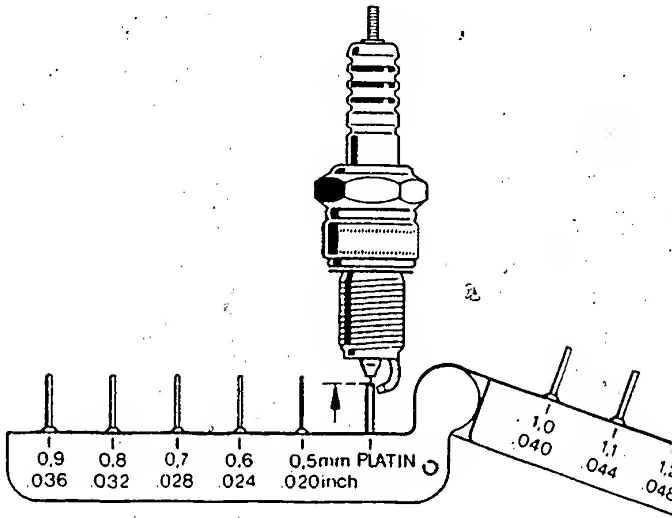
The previous method of assessing the wear of a spark plug by the erosion of the electrode alone no longer applies to this type of spark plug, since the wear of the platinum center electrode in the insulator nose must be taken into account.

Should it become necessary to assess the wear of a platinum spark plug, this can be done as follows:



Using Bosch illuminating magnifier 1 987 600 005, look into the hole in the insulator nose. Turn the plug in order to get a better view (see illustration, arrow). If the platinum (shiny, also in part with beaded and punctiform surface) is visible far into the hole in the insulator nose, then the spark plug can still be used.

If platinum is no longer visible, it may be that the plug is worn. If in particular instances it is necessary to test the degree of wear, the ground electrode must be bent up with the bending lever on the spark-plug-gap gauge far enough to allow the gauge wire for platinum spark plugs to be inserted into the hole in the insulator nose of the plug. This should be done only in exceptional instances and only for monitoring puposes, as it renders the spark plug unusable.



The platinum pin is completely worn if the gauge wire can be inserted into the hole in the insulator nose all the way to the plastic stop (see arrow in illustration).

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department
for Training and Technology (KH/VSK)

Please direct questions and comments concerning the contents to our authorized representative in your country.
Initiated by: K1/VAK

Danger of Accident on Semi-conductor Ignition Systems

Please be sure to pass this bulletin on to your employees for their attention.

The increased demands made on their ignition systems by modern engines, and the wish for freedom from maintenance, led some time ago to manufactures starting to equip their vehicles with semi-conductor ignition systems as original equipment. In most cases the performance of nearly all makes of such systems is higher than that of conventional systems, and further improvements are to be expected. This means that semi-conductor ignition systems have reached the point where contact with "live" parts or contacts (whether on the primary side or the secondary side) can prove fatal.

In this connection we should like to point out to you that the laws valid in your country regarding work on high-voltage systems must be adhered to when working on, or testing, semi-conductor ignition systems.

As a matter of principle, when working on such ignition systems the ignition is to be switched off. Included in such work are the following operations:

- Connection of engine testing equipment (timing light, dwell-tach tester, ignition oscilloscope etc.).
- Replacement of ignition system parts (spark plugs, ignition coil, ignition distributor, H.T. ignition cables etc.).

If it is necessary to switch on the ignition in order to test the system or make adjustments on the engine (to the carburetor for instance), then lethal voltages are present throughout the entire system.

This means that the danger of accident exists not only at individual components in the system (e.g. ignition distributor, ignition coil, trigger box, ignition harness), but also at the wiring harness (e.g. connection for the tachometer, diagnostic connector), on terminals, and on test equipment.

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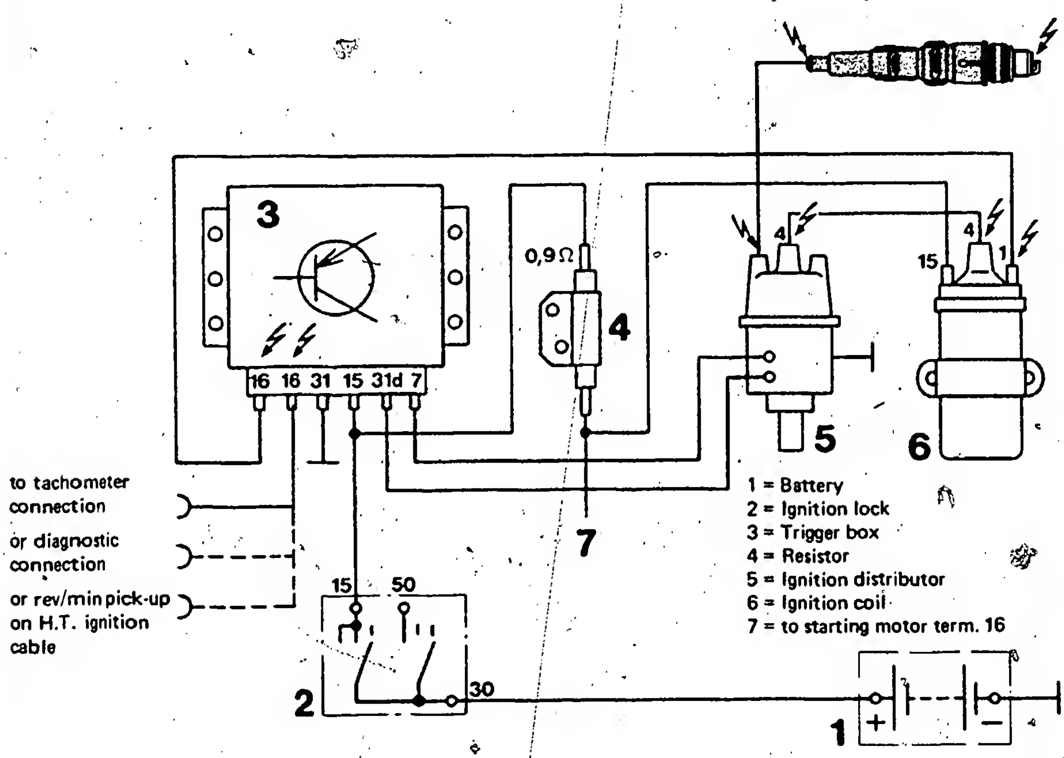
Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung.

In addition, in the case of the capacitor-discharge ignition system (CDI), danger of accident is also present under the following circumstances:

- Operation of the trigger box without the ignition transformer.
- At the trigger box, (removed), relatively soon after it has been switched off (capacitor discharge).

Below is a typical terminal diagram of a semi-conductor ignition system, the danger points are marked with red high-voltage arrows. We would point out that all semi-conductor ignition systems, even the older ones, are to be regarded as dangerous in the sense as defined by this bulletin.

Please address any queries or comments concerning the contents of this publication to our representative in your country.



Terminal diagram

NEW DESIGNATIONS FOR IGNITION SYSTEMS

VDT-I-227/108 En
1.1983

The introduction of new ignition systems has made it necessary to reclassify all designations.

The designations listed below will be used immediately in KH workshop and sales literature.

Designation	Abbrev'd code	Meaning	Switching	Ignition control and spark advance	High-voltage distribution
Coil ignition	SZ (CI)	---------	Mechanical (breaker points)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistor-ized coil ignition	TSZ-K (TCI-C)	K=breaker-triggered	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Trigger box with conventional circuit techniques	TSZ-I* (TCI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
	TSZ-H	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistor-ized ignition	TZ-I* (TI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
(Trigger box in Hybrid technique)	TZ-H* (TI-h)	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)

BOSCH Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.
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Designation	Abbrev'd code	Meaning	Switching	Ignition control and spark advance	High-voltage distribution
Breakerless semiconductor ignition with or without knock control	EZ EZ-K	- K=Knock control	Electronic (trigger box or control unit)	Electronic (control unit)	Mechanical (ignition distributor or high-voltage distributor)
Distributor-less ignition with or without knock control	VZ VZ-K	- K=Knock control	Electronic (control unit)	Electronic (control unit)	Electronic (dual-spark ignition coil, or 1 ignition coil for each spark plug)

*Note: The ignition system can also be equipped with a DLS unit (digital idle stabilization) or with an ELS unit (electronic idle stabilization) or with an ESV unit (electronic ignition retardation).

PLUG-AND-SOCKET PARTS SETS FOR IGNITION COMPONENTS
(Ignition distributors/trigger boxes)

Parts sets are available for replacement wiring-harness plug-and-socket connectors. The parts sets comprise: connector housing, protective cap (rubber sleeve) and contact springs.
These parts sets are listed on microfiche EE..*.

* See microfiche EE00 under 0 227 ..

Plug, black, 2-pin, parts set 1 287 013 002
Ignition distributor 0 237 .. (ZV-I)

Socket, black, 2-pin, parts set 1 287 013 001
Ignition distributor 0 237 .. (ZV-I)

Socket, black, 3-pin, parts set 1 237 000 039
Ignition distributor 0 237 .. (ZV-H)

Socket, black, 6-pin, parts set 2 227 000 100
Trigger boxes 0 227 100 0.. (e.g. 0 227 100 014)

Socket, black, 2x3-pin, parts set 2 227 000 101
Trigger boxes 0 227 100 0.. (e.g. 0 227 100 011)

Socket black, 6-pin, parts set 2 227 000 104
Trigger boxes 0 227 100 0.. (e.g. 0 227 100 019)

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D17

Socket, black, 7-pin, parts set 2 227 000 111.
Trigger boxes 0 227 100 1.. (e.g. 0 227 100 103)

Contact spring, narrow (minitimer) 1 284 477 026 and contact spring, wide (timer) 1 224 477 026 can also be supplied separately.

The connector housings are only available in the stated colours.

Please direct questions and comments concerning the contents to our authorized representative in your country.

KNOCK SENSOR — VDT-I-227/110 En

0 261 231 .. — 3.1983

Procedures for after-sales service

Description

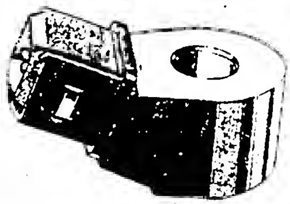
The knock sensor contains an active piezoceramic element. It is screwed to a chosen position on the engine block and sends a structure-borne signal which is processed further by an electronic control unit.

User

Saab is the first vehicle manufacturer to use the knock sensor which is being fitted to various turbo vehicles.

Components

Knock sensor 0 261 231 ... *



* The exact part numbers are given on the appropriate vehicle-equipment microcards AA... .

Service/exchange parts

The knock sensor is a service part and is supplied by Bosch. The remaining components of the knock control are products made by other firms.

Technical documentation

Technical bulletin "New product" VDT-I-227/10 En.

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Training

Special training is not necessary.

Retrofitting

The knock sensor is not intended for retrofitting.

Warranty procedure

Components on which a claim is being made should be sent for inspection during the warranty period to our representative in your country. He should forward it to:

ROBERT BOSCH GMBH
KH/LAV - Auspackraum
zur Weiterleitung an K1/VAK2
7000 Stuttgart 30
Federal Republic of Germany

This regulation applies until further notice.

Electrical equipment

VDT-I-Gen. 067 En

9.1984

ELECTRONIC ROTATIONAL SPEED LIMITERS
B 227 080 0..

Electronic rotational speed limiters B 227 080 005 ... 018 are intended for use in competition racing. They must not be used in conventional highway traffic because Bosch does not have any homologation ("ABE") from the Federal authorities for that.

If they are installed nonethless, the homologation becomes invalid, and the vehicle is considered as unlicensed.

For use in competition racing, the electronic rotational speed limiters can be obtained from:

Robert Bosch GmbH
Competition Racing Service K3/MSD
D-7141 Schwieberdingen

They are not available from the Automotive Equipment Aftermarket Division KH.

Please direct questions and comments on the contents to our authorized representative in your country.

Motor Vehicle Service Information

BOSCH Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung.

ROTATIONAL-SPEED RELAYS

0 333 400 ..
0 335 530 ..

Testing in the Vehicle

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung

D22

This publication has been redesigned with the forthcoming change-over to microfilm in mind.
When a publication has been transferred to microfilm, the screen will be filled completely by a quarter of a printed publication page. For this reason, it is unavoidable that illustrations are repeated in the case of longer texts in which reference is constantly being made to a particular illustration.
Until the change-over to microfilm, we have slightly reduced the size of the print and of the illustrations.

Contents	Coordinate
1. General	A 3
2. Testing in the vehicle	A 4
3. Test circuits	A 5

Automotive Equipment - After-Sales Service
Department for Technical Publications KH/VDT;
Postfach 50, D-7000 Stuttgart 1.

Published by: After-Sales Service Department for Training and Technology (KH/VSK). Press date: 3.1981.

Please direct questions and comments concerning the contents to our authorized representative in your country.

1. General

The rotational-speed relay switches valves or solenoids in the vehicle on or off at certain engine speeds.

The rotational-speed relay obtains the engine-speed pulses from terminal 1 of the ignition coil.

During functional testing, the load (valve or solenoid) is replaced by a test lamp.

Defective rotational-speed relays are not to be repaired.

2. Testing in the vehicle

Pull off plug-in connections from the rotational-speed relay.
Switch on the ignition and test the voltage at the plug-in contact for the power supply.

(On rotational-speed relay 0 335 530 016 plug-in contact 5.
On all other relays plug-in contact 2).

Voltage: 11.9 ... 14.5 V
Switch off the ignition.

Testing in the vehicle (continued)

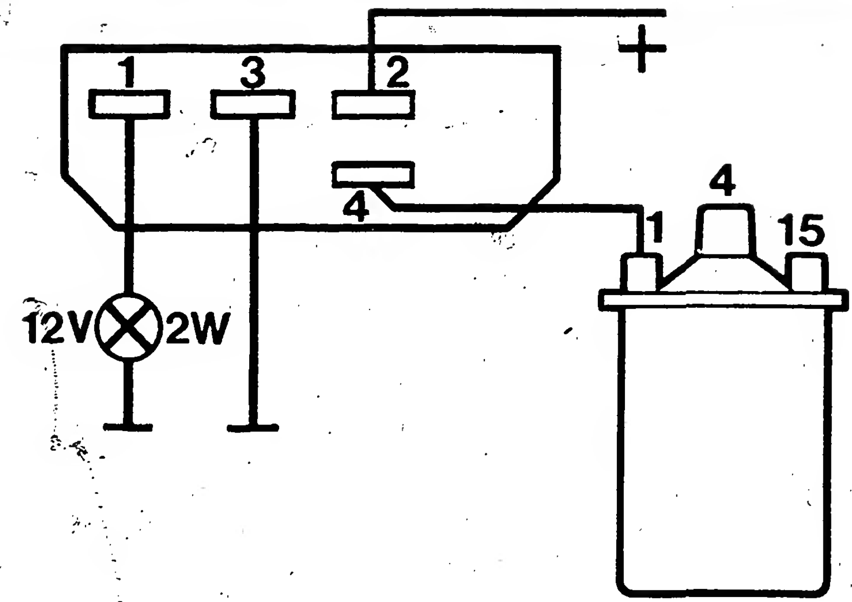
Connect a 12 V 2 W test lamp to the plug-in contact for terminal 1 of the ignition coil and to ground:
On rotational-speed relay 0 335 530 016 plug-in contact 8.
On all other relays plug-in contact 4.

Start the engine:
The test lamp must flash in time with the switching frequency of the contact breaker.
Switch off the engine.
Re-connect plug to rotational-speed relay.
Connect the test lamps in accordance with the circuit diagrams given above the following tables.
Disconnect the load (solenoid-operated valve) and connect the test lamp instead.
Start the engine and increase the engine speed until the test lamps light up.

With 0 335 530 005 the test lamp goes out in this case.
Read off the engine speed and compare it with the speed given in the corresponding table.

Increase the engine speed by approx. 150 min^{-1} and then reduce until the test lamp goes out.

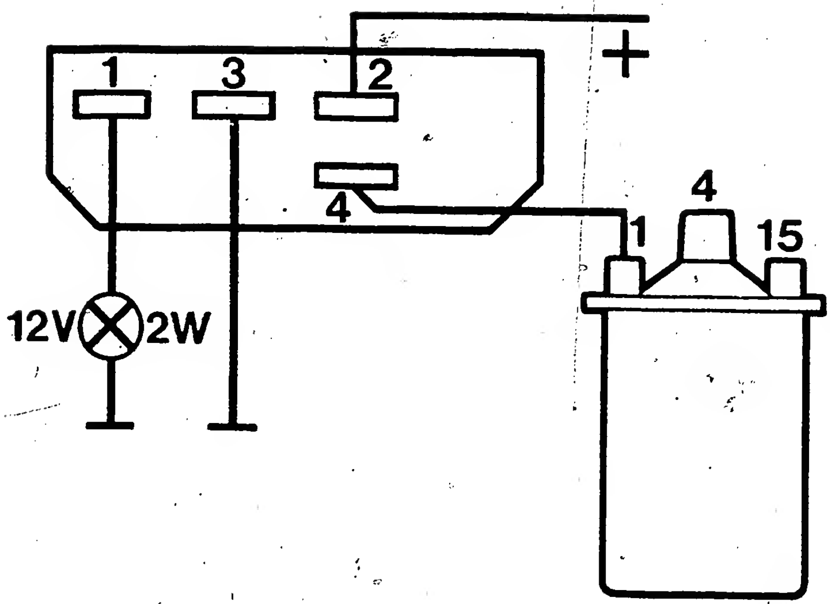
With 0 335 530 005 the test lamp lights up in this case.
Compare the measured engine speed with the table.
Tolerances must be complied with.



3. Test circuit

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out-speed with decreasing engine speed min^{-1}
0 333 400 001 (0 336 611 001)	1520 ± 60	1350 ± 60
0 333 400 002 (0 336 611 002)	2450 ± 60	2150 ± 60
0 333 400 003 (0 336 611 003)	1930 ± 60	1800 ± 60
0 333 400 004 (0 336 611 004)	2050 ± 60	1750 ± 60
0 333 400 006 (0 336 611 006)	1610 ± 60	1500 ± 60

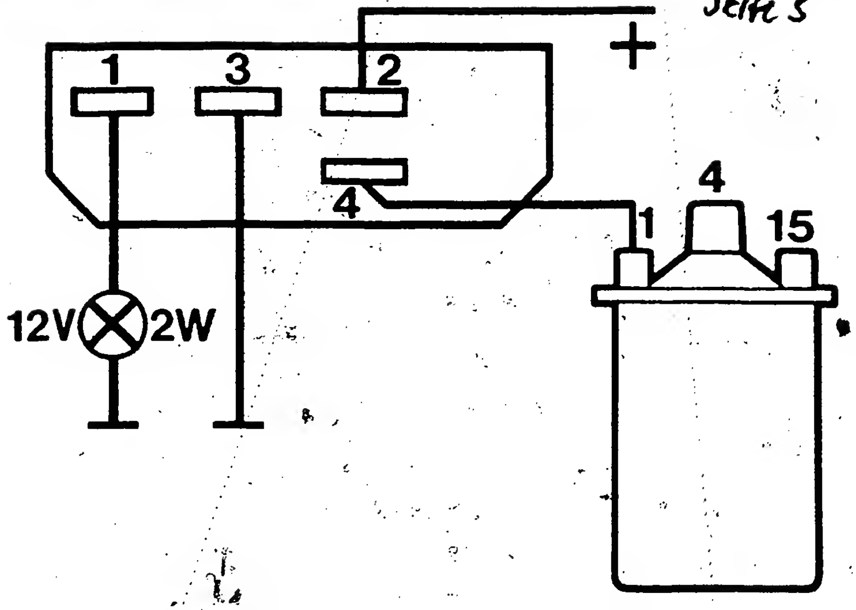
Test circuit
Rotational-speed relays



3. Test circuit (continued)

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out speed with decreasing engine speed min^{-1}
0 333 400 007 (0 336 611 007)	1920 ± 60	1800 ± 60
0 333 400 008 (0 336 611 008)	1910 ± 60	1610 ± 60

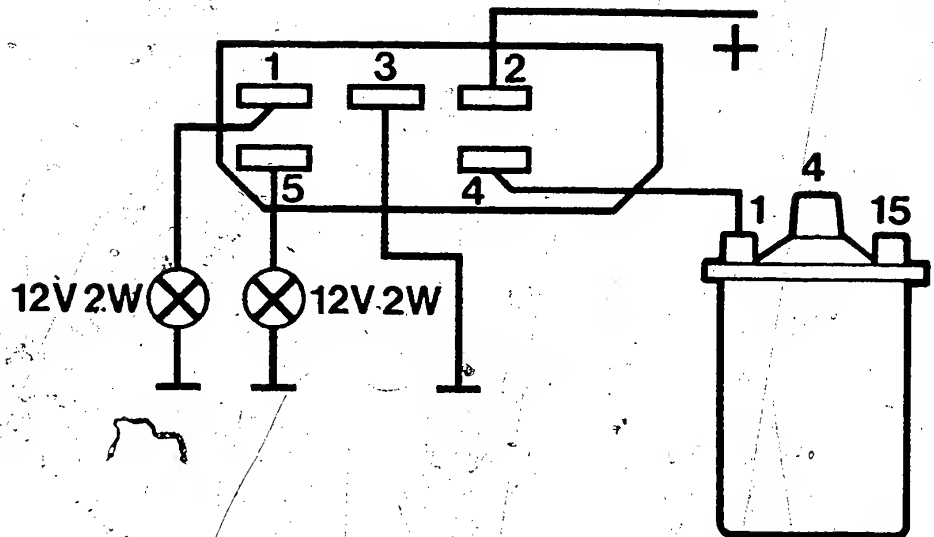
Seite 3



3. Test circuit (continued)

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out speed with decreasing engine speed min^{-1}
0 335 530 003	2500 ± 50	2000 ± 50
0 335 530 004	2500 ± 50	2000 ± 50
0 335 530 005	2500 ± 100	2200 ± 100
0 335 530 006	1800 ± 50	1600 ± 50
0 335 530 011	1750 ± 50	1700 ± 50
0 335 530 012	1750 ± 50	1700 ± 50
0 335 530 013	1850 ± 50	1650 ± 50
0 335 530 017	1950 ± 50	1850 ± 50
0 335 530 023	3500 ± 200	Hysteresis 50-100

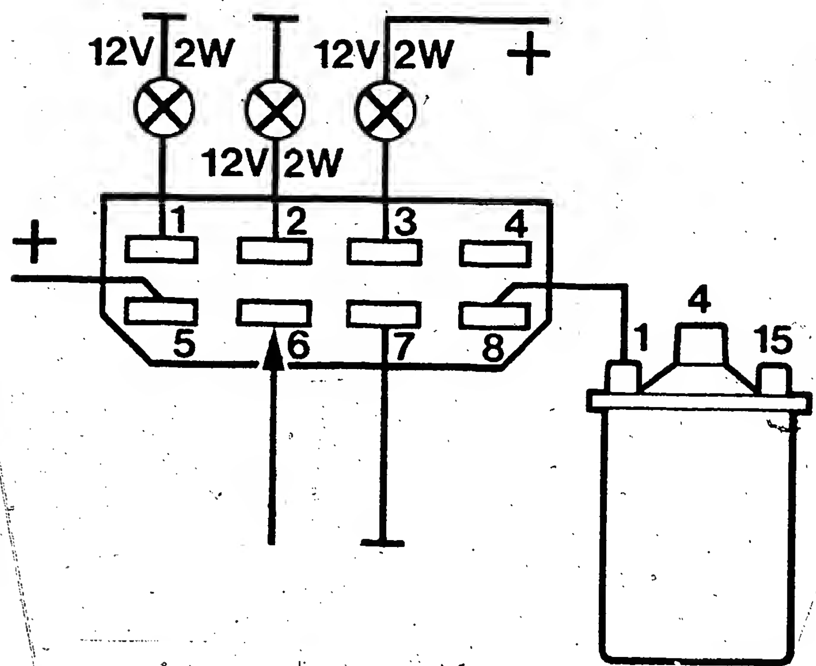
Test circuit
Rotational-speed relays



3. Test circuit (continued)

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out speed with decreasing engine speed min^{-1}
0 335 530 008	3200 ± 150	3000 ± 150
0 335 530 014	3950 ± 150	3750 ± 150
0 335 530 015	3950 ± 150	3750 ± 150
0 335 530 018	3950 ± 150	3750 ± 150
0 335 530 019	3950 ± 150	3750 ± 150
0 335 530 020	3950 ± 150	3750 ± 150

Contacts 1 and 5:
Both lamps must light up simultaneously.

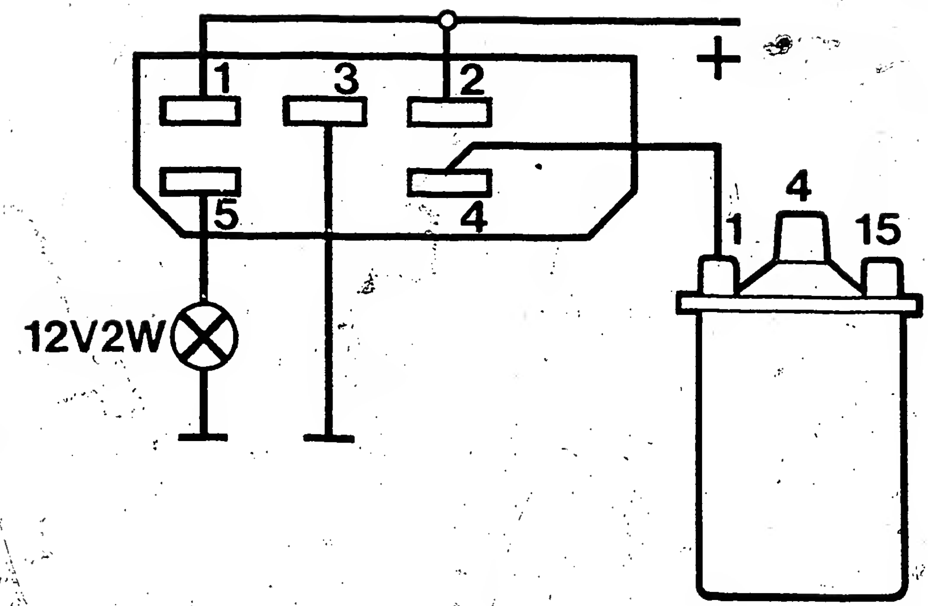


3. Test circuit (continued)

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out speed with decreasing engine speed min^{-1}
0 335 530 016	1800 $\pm$ 50	Hysteresis 25-50

Touch contact 6 against ground:
Lamp on contact 2 goes out.
Lamp on contact 1 lights up.

Test circuit	
Rotational-speed relays	



3. Test circuit (continued)

Rotational-speed relay	Cut-in speed with increasing engine speed min^{-1}	Cut-out speed with decreasing engine speed min^{-1}
0 335 530 021	3400 ± 150	3200 ± 150
0 335 530 022	4100 ± 150	3900 ± 150

Test circuit Rotational-speed relays	

E3

-1-230/101 ZV
VDT-BME 121/89 B 23

Edition 9.1974
Translation of German
edition of 28.5.1974

0 231 ..
Short-type Ignition Distributor

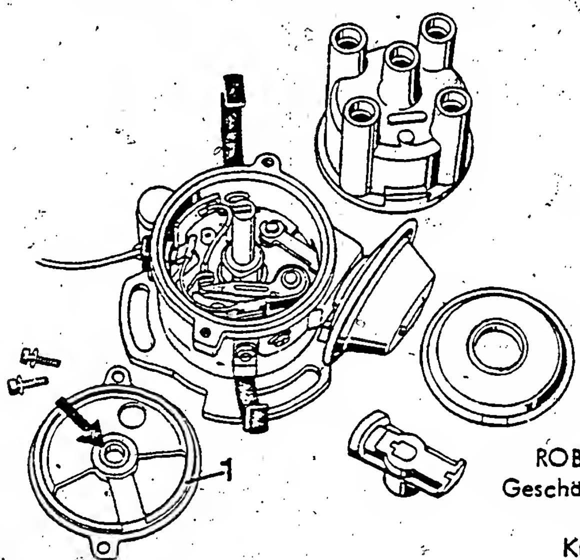
The arrangement of the second shaft bearing (bearing plate) above the contact points means that the following points must at all costs be observed during maintenance work.

1. The bearing plate must be removed when the contact points are taken out or installed, care being taken not to dirty the bushing. Once the bearing plate has been removed the distributor may not be driven by either the engine or the test bench, because otherwise the lower bushing will be damaged. Neither the dwell angle nor the contact gap may be adjusted without the bearing plate, since this would result in incorrect settings.

2. Every time the contact points are changed, a drop of oil must be applied (see arrow) to the upper bushing (Ol 1 v 13, Oil can 0.05 l - Part No. 5 701 042 350
Oil can 0.5 l - Part No. 5 701 042 605
Oil can 1.0 l - Part No. 5 701 042 610)
or Esso Milkot K - 50 or Shell Vitrea 37).

3. The self-lubricating bushing force-fitted in the bearing plate is pre-lubricated. The bearing plate must therefore not be washed in petrol or any similar substance.

In case of inquiry, please contact your authorized representative.



1 = Bearing plate

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Handel
Kundendienstschule

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If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

Esta información está disponible únicamente en alemán. En caso necesario, sírvase dirigirse a su Representación Regional.

Questa informazione è disponibile solo in lingua tedesca. Se necessario, rivolgersi al proprio rappresentante di zona.

This information is available only in German. If necessary, please contact your regional representative.

Cette information n'est disponible qu'en allemand. Le cas échéant, veuillez vous adresser à votre représentation régionale.

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E6

VDT-I-230/102 B

Suppl. 1 10.1975
Ed. 1
Translation of German
edition of 1.10.1975

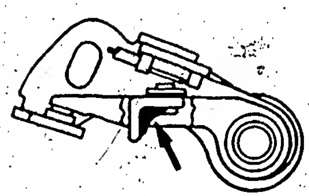
Distributor contact points for Daimler-Benz 3.5 and 4.5 l engines.

In addition to the screened control leads (TCI), which have already been dealt with a new distributor contact set has been specified for the engines quoted above.

old:	new:	for:
1 237 013 084	.. 142	ZV 0 231 401 .. and 402
1 237 013 110	.. 128	ZV 0 231 403 ..,
		0 231 401 004 und
		0 231 402 008
		0 231 404 002

The new sets contain a grease capsule (not shown) (1 217 402 001) with grease Ft 1 v 4 and a cover 1 230 583 004. The rubbing block is of extra-hard-wearing polyimide.

Lubrication as usual (see Fig.).



The new cover must be fitted.

The contact sets for the 6-cyl. and 4-cyl. engines have not changed, and the original types will continue to be fitted. Care must be taken to route the wiring correctly.

In case of inquiry, please contact your authorized representative.

Published by:
Trade Division K 1
Dept. K 1/VAK 6

BOSCH

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Removal of the Ignition Condenser

In our technical bulletin VDT-I-230/102 B Ed. 1 together with the supplement of 10.75 we dealt specially with the maintenance of distributor contact points. At the same time the practicability of removing the ignition condenser was described in conjunction with the TCI ignition system (breaker-triggered).

To prevent any misunderstandings we would like to point out as a precaution, that this recommendation can not, of course, be applied to conventional ignition systems, due to the high switching currents involved.

Here, as before, the condenser on the ignition distributor is absolutely essential for spark suppression. A missing or faulty (open-circuit) ignition condenser leads to heavy contact arcing with extreme contact wear, bad ignition performance and finally to complete failure of the ignition system.

The testing procedure for ignition condensers is contained in VDT-WPE 120/2 B. In doubtful cases we recommend the replacement of the ignition condenser.

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Breakerless Ignition Distributor 0 231 . . with Hall Generator

New Breakerless, Maintenance-Free Inductive Semiconductor Ignition System

1. General

The electrical process designated the "Hall effect" (discovered by the American physicist Hall in 1879) has been known for many years, but only as a result of the recent development of new materials has it become possible to employ this effect in the field of automatic-control engineering. The Hall effect arises when a supply current (I_V) is passed through a semiconductor layer and this layer is subjected to a magnetic field, as shown in Fig. 1. This then leads to the development of a voltage, the so-called "Hall voltage" (U_H), on the transverse sides of the semiconductor layer.

In certain materials, for example silicon, the Hall voltage is strong enough for a current, the so-called Hall current (I_H), to be taken from the sides of the semiconductor layer marked + and – (see Fig. 1); hence the term "Hall generator".

Fig. 2 shows the block circuit diagram of a Hall IC. All of the circuits shown in this diagram – designated by their corresponding functions – are contained on a single semiconductor chip with an area about 1 mm² and form part of the ignition vane switch (Fig. 3).

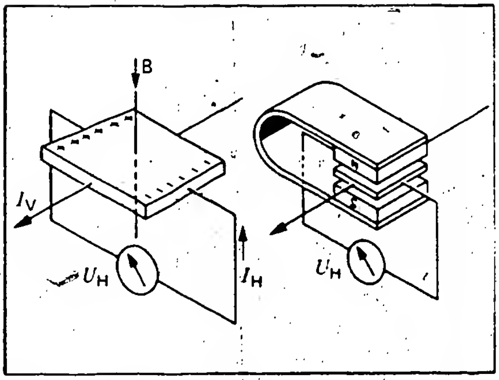

Fig. 1 Hall effect

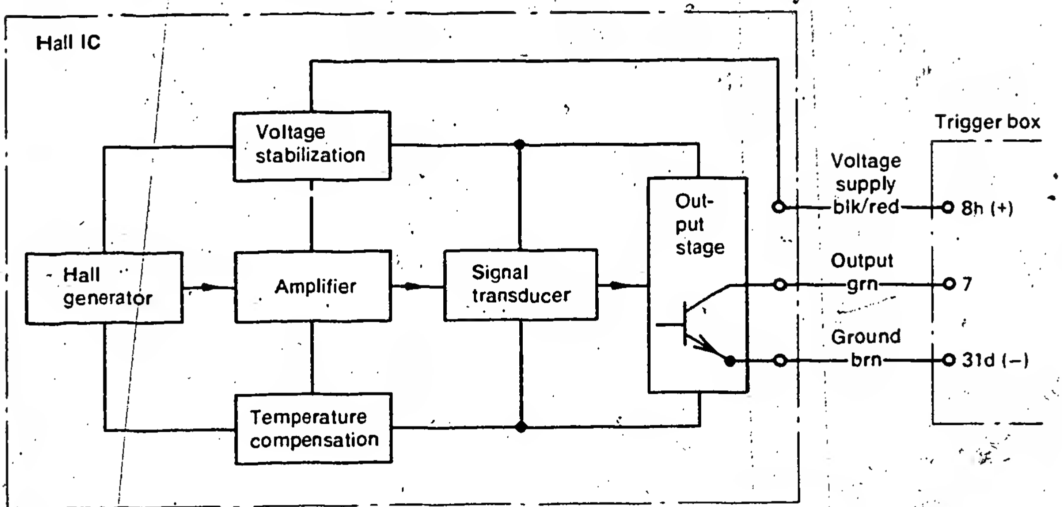

Fig. 2 Block circuit diagram of the Hall IC

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E9

Ec9

2. Construction

Fig. 3 shows the complete Hall generator system.

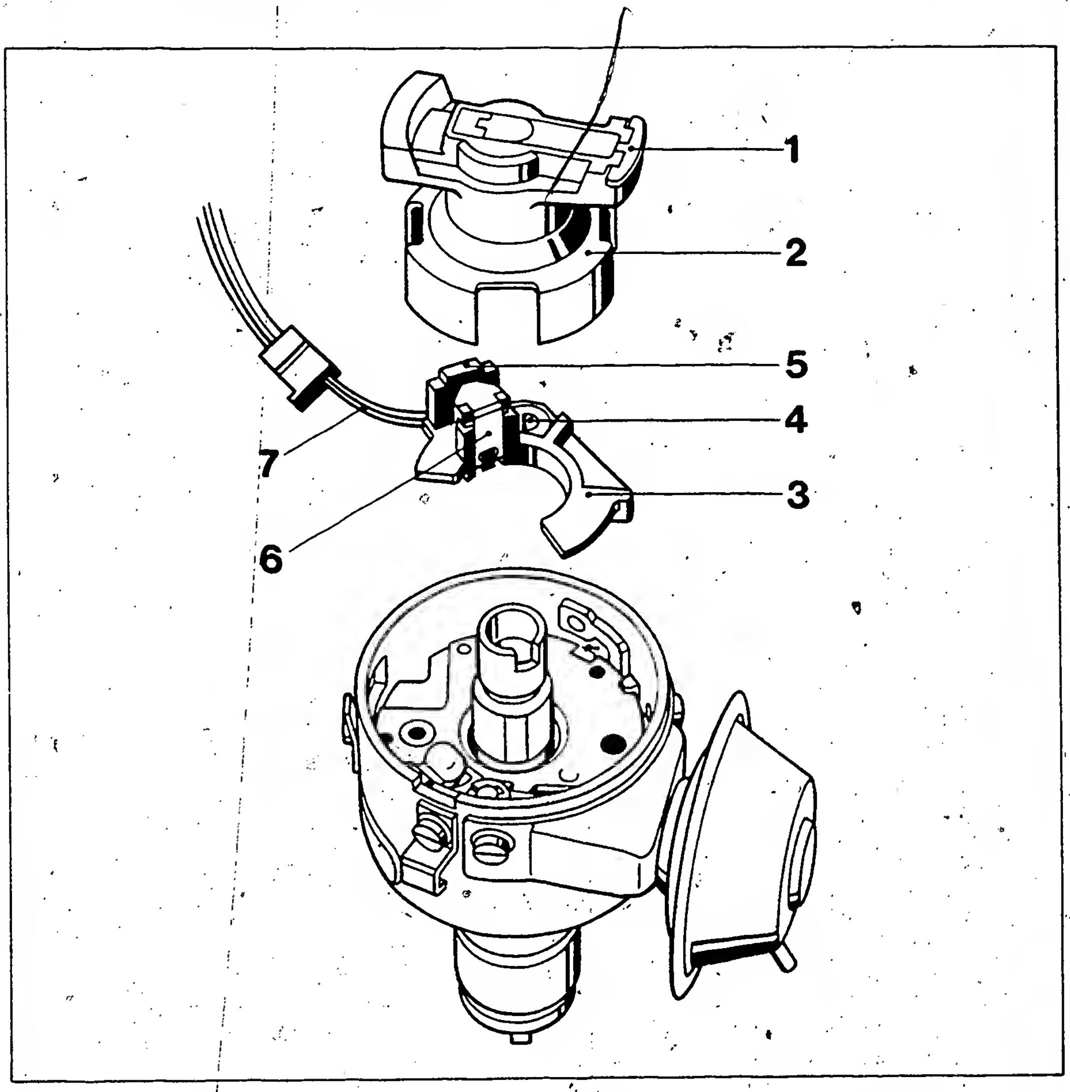


Fig. 3 Hall generator system

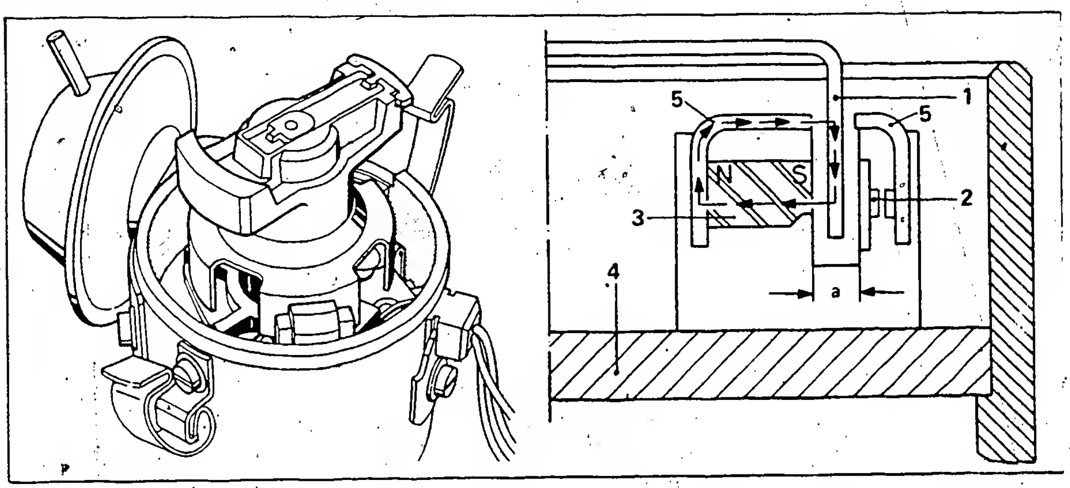
1 = Distributor rotor with trigger wheel
2 = Trigger wheel
3 = Ignition vane switch
4 = Fastening
5 = Hall IC
6 = Magnet
7 = Pick-up leads

3. Operation

The ignition vane switch (Hall IC, magnetic circuit), together with the trigger wheel (made of magnetically soft steel), forms the "Hall generator".
An alnico permanent magnet generates a magnetic field, which, passing through the conductor plates to the Hall IC, is alternately interrupted and allowed to pass through the vanes in the air gap. The number of vanes equals the number of engine cylinders. When a vane enters the air gap, the magnetic field is directed past (bypasses) the Hall IC, whose output is blocked (Fig. 4).
The output stage of the trigger box is now conductive. A primary current flows through the ignition coil.

Fig. 4 Vane in air gap, magnetic field bypasses Hall IC.

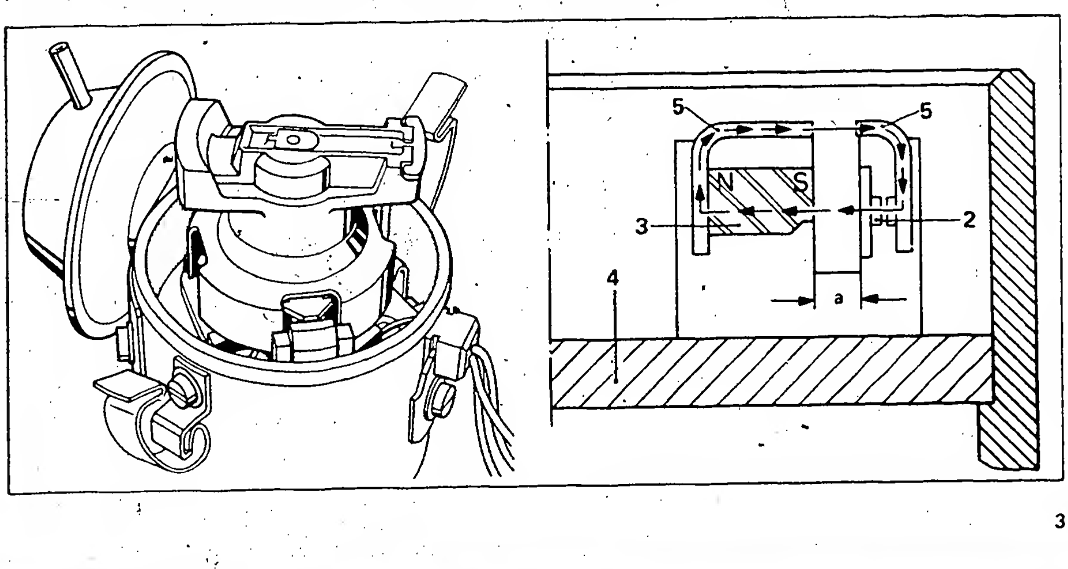
1 = Trigger wheel
2 = Hall IC
3 = Magnet
4 = Ignition vane switch
5 = Conductor plates
a = Air gap



The Hall IC output conducts when the vane leaves the air gap because the magnetic field now saturates the semiconductor layer (Fig. 5).
The output stage of the trigger box is blocked and the primary current thus interrupted (ignition point).

Fig. 5 Vane outside air gap, Hall IC is saturated by the magnetic field.

2 = Hall IC
3 = Magnet
4 = Ignition vane switch
5 = Conductor plates
a = Air gap



Voltage is supplied to the Hall IC via the trigger box through the black/red (plus) and brown (minus) cables. Depending on the position of the vanes, the green output lead is alternately at plus voltage (blocked) or at minus potential (conducting).
When this system is used, the dwell angle cannot be adjusted; it is determined by the breadth of the vanes (Fig. 6) and remains constant.
At the ignition point of cylinder no. 1 the center of the distributor rotor electrode must point to the notch in the edge of the ignition distributor housing (similar to breaker-triggered distributors) as shown by Fig. 6. In this position (Ignition point of cylinder No. 1), the edge of the vane must also be positioned as shown in Fig. 7. If this is not the case, the wrong distributor rotor has been installed (engine misfires, burbles).

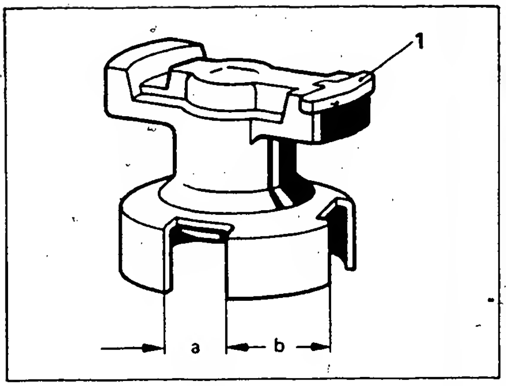


Fig. 6 Control of dwell angle

1 = Distributor rotor electrode
a = Gap (opened angle)
b = Breadth of vane (dwell angle)

4. Operation of Trigger Box

See VDT-I-227/2 B.

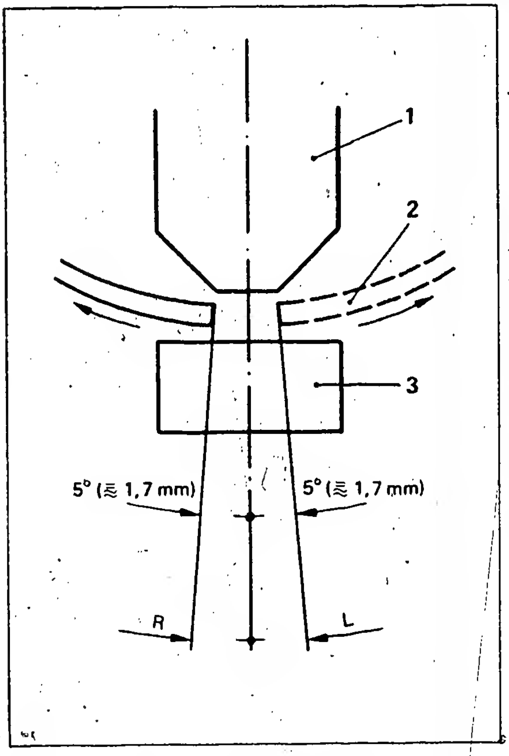


Fig. 7 Position of a vane at ignition point

1 = Magnet
2 = Vane
3 = Hall IC

Position of the edge of the vane at the ignition point
L = Counterclockwise rotation of ignition distributor
R = Clockwise rotation of ignition distributor

Breakerless Ignition Distributor 0 231 . . with retrofitted Hall generator

General

For the new breakerless, maintenance-free transistorized ignition system from Bosch.

Modification set for vehicles with 4-cylinder engine and Bosch ignition distributor, in some cases for vehicles as far back as the 1972 model. See also VDT-I-227/2 B, VDT-I-231/1 B and KH-Information "New breakerless, maintenance free transistorized ignition system TSZ-h".

Ignition Distributor - Modification

Lift off the distributor cap (1). Remove the distributor rotor (2) and dust-protection cover (3).
Remove distributor contact points (4).
Cut the ground connection (copper stranded wire) from the breaker-plate assembly to the distributor housing at both points of connection and remove it (see Fig. 2) .

Unscrew ignition condenser (5) and remove together with connecting leads.

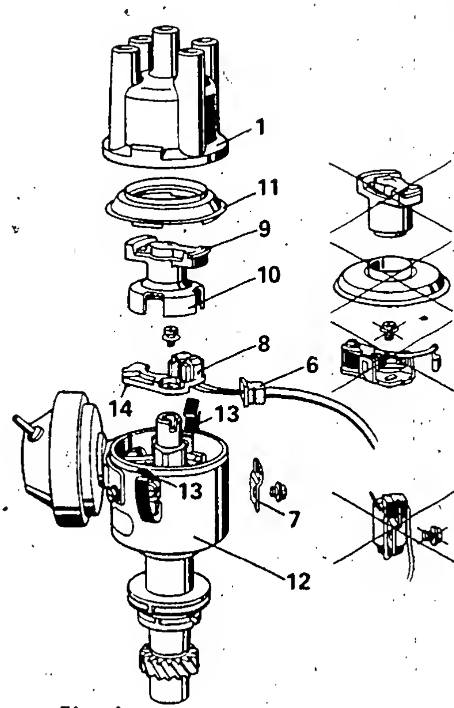


Fig. 1

Feed the leads of the ignition vane switch through the opening in the distributor from the inside and press the shaped piece(6) into the opening.
The shaped piece should be so positioned that the three thin leads are in its lower half.
Do not twist the leads to the vane switch.
Slip the metal holder (7) into the groove in the shaped piece and screw in place with the short screw supplied. Snap the ignition vane switch (8) with locating piece (14) into the breaker-plate assembly and screw in place with the long screw provided.

1 = Distributor cap
2 = Distributor rotor
3 = Dust protection cover
4 = Contact point
5 = Ignition condenser
6 = Shaped piece
7 = Sheet metal holder
8 = Ignition vane switch
9 = Distributor rotor with 10
10 = Trigger wheel
11 = Dust protection cover
12 = Distributor housing
13 = Spring clip
14 = Locating piece
X = Parts no longer required

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Slip (snap in place) the new distributor rotor (9) with trigger wheel (10) onto the ignition-distributor shaft.
Place the new dust-protection cover (11) over the distributor housing (12) and snap into place.

Fit the distributor cap and secure with the spring clips (13).

Slip the insulating tubing over the ignition vane switch leads.

Caution! The ignition vane switch will be destroyed if the polarity is wrong.

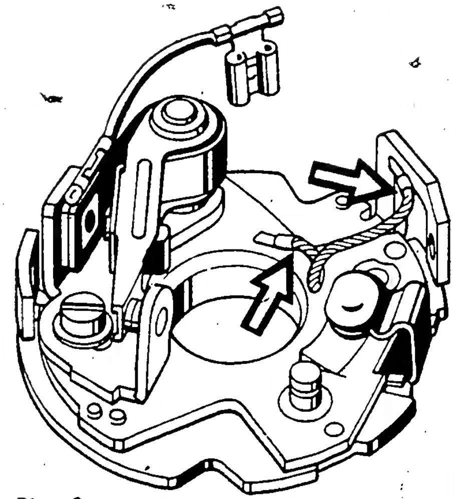

Fig. 2

RETROFITTING OF TCI-h
in vehicles with short-type ignition distributor
0 231 186 ..

The short-type ignition distributor 0 231 186 .. (with contact breaker) cannot be converted to a breakerless type by fitting a Hall pulse generator.

Reason

For design reasons, the distributor shaft in this type of ignition distributor is also supported by a bushing above the breaker-plate assembly. Due to the upper bushing plate, it is impossible to push a distributor rotor together with trigger wheel onto the distributor shaft (in this connection see VDT-I-230/101).

Those vehicles which are equipped with a short-type ignition distributor though, can be retrofitted with breaker-triggered transistorized ignition system TCI-c, 0 227 051 906.

At present, the following vehicles are equipped with the short-type distributor:

VAG (VW/Audi)	Audi 50 with 1.1/1.3 l engine
	Audi 80 (4000) with 1.3 l engine
	Polo, Derby with 0.8 ... 1.3 l engine
	Golf (Rabbit), Scirocco with 1.1 l engine
	Passat (Dasher), Jetta with 1.3 l engine
Opel	Opel Kadett D with 1.3 l engine.

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IGNITION-DISTRIBUTOR ROTOR

with speed limitation
023 ..

VDT-I-231/104 En
4.1981

Cross-reference of distributor rotors with and without speed limitation and with details of cutoff speed.

Instructions relating to the certificate of registration in the Federal Republic of Germany (In other countries the relevant regulations should be observed).

The fitting of a distributor rotor with limitation is permitted, when the output and rated engine speed of the vehicles are not thereby affected (see certificate of registration, column A, paragraph 7). The cutoff speed must not be lower than the rated engine speed.

When a distributor rotor without limitation is fitted in vehicles which have as original equipment a distributor rotor with limitation, or in the certificate of registration of which a distributor rotor with limitation is entered, the general homologation (ABE) is no longer valid.

Distributor rotor without speed limitation	Distributor rotor with speed limitation	Cutoff speed min^{-1}
1 234 332 173	1 234 332 284	5.900
1 234 332 173	1 234 332 317	6.100
1 234 332 173	1 234 332 272	6.200
1 234 332 173	1 234 332 225	6.300
1 234 332 173	1 234 332 196	6.600
1 234 332 173	1 234 332 223	7.000
1 234 332 177	1 234 332 217	5.300
1 234 332 177	1 234 332 203	5.850
1 234 332 177	1 234 332 238	6.300
1 234 332 177	1 234 332 202	6.500
1 234 332 215	1 234 332 218	3.600
1 234 332 215	1 234 332 192	4.500
1 234 332 215	1 234 332 209	5.300
1 234 332 215	1 234 332 144	5.400
1 234 332 215	1 234 332 207	5.800
1 234 332 215	1 234 332 222	6.000

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Distributor rotor without speed limitation	Distributor rotor with speed limitation	Cutoff speed min^{-1}
1 234 332 215	1 234 332 220	6.350
1 234 332 215	1 234 332 288	6.400
1 234 332 215	1 234 332 198	6.500
1 234 332 215	1 234 332 208	6.600
1 234 332 215	1 234 332 242	6.700
1 234 332 215	1 234 332 199	6.800
1 234 332 215	1 234 332 224	6.900
1 234 332 215	1 234 332 221	7.000
1 234 332 215	1 234 332 205	7.100
1 234 332 215	1 234 332 206	7.300
1 234 332 271	1 234 332 297	6.600
1 234 332 271	1 234 332 299	6.700
1 234 332 271	1 234 332 274	6.900

Electrical equipment

BONDED DISTRIBUTOR ROTORS

VDT-I-KFZ 100 En

01.1986

On the below-listed vehicles/ignition distributors, the distributor rotors have been bonded onto the distributor shaft to counter heavy vibrations.

Bonded distributor rotors are not stocked as a wearing part (on service-parts microcard) in the after-sales service because mounting takes too much time and effort. This means that, in the case of a defective distributor rotor, it is necessary to replace the entire ignition distributor.

This concerns the following vehicles/ignition distributors:

Vehicles	Distributors
Audi Quattro S 220 kW	0 237 522 001
Audi 90 Quattro Italy, 4 valves	0 237 522 007
Audi 80 GTE, 4 valves	0 237 521 010
Golf, 4 valves	0 237 521 010
Scirocco, 4 valves	0 237 521 010
Nissan Santana, 4 valves	0 237 522 007
Saab 900, 9000, 4 valves	0 237 506 006
	0 237 506 009
	0 237 507 001
	0 237 507 006
	0 237 507 007

Published by:
Robert Bosch GmbH
Division KH
After-Sales Service Department for Training and Technology (KH/VSK)
Please direct questions and comments concerning the contents to our authorized representative in your country.

Motor Vehicle Service Information

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GLOW-DURATION UNIT

0 333 402 512

Defect due to voltage spikes

With the above-quoted glow-duration unit up to FD 549 (number stamped on pack or on unit less than 52 85) ~~it~~ is possible for a defect to occur on the glow-duration unit as a result of positive voltage spikes.

The defect can be recognized by the fact that the glow-plug indicator lamp does not go out after the preheating time has expired. It is possible for the sheathed-element glow plugs to remain on, which will drain the vehicle battery.

This defect no longer occurs in glow-duration units as of FD 550.

Please check your inventory of glow-duration units and return any existing stocks (up to FD 549) which will be credited to you.

Federal Republic of Germany:
with delivery slip KH/VKD3 - 15 333 to
ROBERT BOSCH GMBH
KH/QSG
Auf der Breit 4
D-7500 Karlsruhe 41

Other countries:
Through RG/AV with delivery slip to:
ROBERT BOSCH GMBH
KH/LAV2 - Auspackraum
zur Weiterleitung an KH/QSG
Auf der Breit 4
D-7500 Karlsruhe 41

Please order your replacement requirements from KH/ALP through the usual channels.

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ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

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